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OPHTHALMOLOGY HC DIXON

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To the Royal London Ophthalmic Hospital
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from the Author.

DISEASES OF THE EYE;

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LONDON OPHTHALMIC HOSPITAL

A TREATISE

CONTRIBUTED TO THE SECOND EDITION OF

HOLMES'S 'SYSTEM OF SURGERY'

BY

JAMES DIXON, F.R.C.S.

CONSULTING-SURGEON TO THE ROYAL LONDON OPHTHALMIC HOSPITAL,
MOORFIELDS.

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MESSRS. LONGMANS AND CO., *as proprietors and publishers of the 'System of Surgery,' edited by Mr. Holmes, have kindly allowed me to print a few copies of the following Treatise for private distribution.*

J. D.

DISEASES OF THE EYE.

CHAPTER I.

OPTICAL DEFECTS.

Emmetropia (*Refraction and Accommodation*).—*Ametropia* (*Myopia, Hypermetropia, Presbyopia, Astigmatism*).

ASSUMING the reader to be acquainted with the general laws of optics, I may begin by saying a few words about the eye as an optical instrument; and may then briefly describe those defects in its refraction and accommodation which interfere with the perfect performance of its functions.

The terms Emmetropia and Ametropia* have been invented by Donders to designate the normal and the abnormal state of the eye in respect of its refractive phenomena. An eye of perfectly normal refraction, in which parallel rays of light meet in a focus on the retina, Donders calls emmetropic—*Emmetropia* implying 'sight within due measure' ("Εμμετρος, within measure, and ὦπια the terminal modification of ὤψ, sight). An eye in which parallel rays come to a focus either in front of or behind the retina, he calls *ametropic* (ὰ and μετρωπία).

Although we familiarly speak of the rays of light that come to us from distant objects as being parallel to each other, yet, strictly speaking, all luminous rays pass off from their source

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* The generic term *Ametropia* is seldom employed, inasmuch as that special form of it which happens to be immediately under observation, leads one to use the terms *Myopia, Hypermetropia*, or *Presbyopia*. But were the word 'Ametropia' often pronounced by Englishmen, it would be constantly liable to be mistaken for 'Emmetropia,' its direct opposite, in consequence of the peculiar sound of our close *a*. On the Continent, where the *a* has uniformly its broad open sound (as in *father*), this confusion cannot occur. Our strictly English eccentricity might have been indulged, while at the same time the distinction between the two generic terms would have been made even more marked, if *Ecmetropia* had been chosen as the converse of *Emmetropia*.

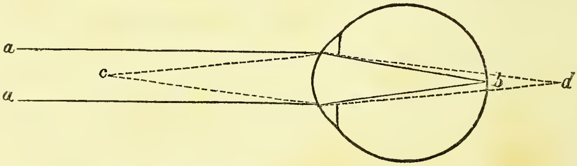
divergently. It is obvious, however, that the divergence of any rays falling on the eye must become less in proportion as their source is removed farther off; so that by the time the rays from a distant object are passing through the small aperture of the pupil, their divergence has become so trifling that, for all practical purposes, they may be regarded as parallel.

In considering the eye as an optical instrument, we have to do only with those rays of light which are admitted by the pupil—they alone being concerned in vision.

While in a perfectly formed, and normally refractive, or emmetropic eye, the rays from distant objects would naturally come to a focus upon the retina, and there form a picture which is to be recognised by the sensorium, the rays from near objects, falling on the surface of the cornea in a state of more or less divergence, would, in passing on through the refractive media of the organ, tend towards a focus behind the retina. (Fig. 140.)

To effect near vision, therefore, it becomes necessary that the media should undergo such a change as will bring divergent rays to an exact focus on the retinal surface. This change is the result of an active effort which is called *Accommodation.*

FIG. 140.



Emmetropic eye in a state of rest. Parallel rays, *a, a,* come to a focus on the retina at *b*. Rays from a near object, *c*, being divergent, tend towards a focus behind the retina, *d*. The act of accommodation, which consists in increased convexity of the lens, causes these divergent rays to converge to a focus at *b*.

Various theories have at different times been suggested to explain the mechanism of this act of adjustment or accommodation of the eye to near objects. First, it was said that by a contraction of the recti muscles the eyeball was compressed on all sides, and thereby elongated in its antero-posterior diameter, and thus the retina was actually removed backwards into such a position as enabled it to receive upon its surface the exact focus of the rays. Secondly, according to another theory, the act of accommodation consisted in an increased curvature of the cornea. This Home and Ramsden considered themselves to have proved by conclusive experiments. Thirdly, it was maintained that the lens was moved bodily forwards.*

Three of the foregoing theories of accommodation are evidently fallacious. 1. In a case of total paralysis of the third, fourth, and sixth nerves, all the ocular muscles are inert, and yet the patient's vision of near objects remains totally unimpaired. 2. The curvature of the cornea has been carefully tested, and found not to vary during the act of accommodation. 3. No apparatus exists adequate to move the entire lens forward to an extent sufficient for the purpose of accommodation. During the performance of the delicate experiments I am about to allude to, no change in the position of the entire lens could be detected. 4. An increase in the convexity of the lens, especially of its anterior surface, is now universally accepted as the cause of the eye being accommodated to near objects.† Theoretically such a change of form will account for the attainment of the end in view; and practically it has been found, by carefully watching the alterations in the reflected images of a flame held in front of the eye, that, while the reflection from the surface of the cornea remains totally unchanged during the act of accommodation, the images reflected from the anterior and posterior faces of the lens (Purkinje's ‡ images they are termed) change both their size and relative position.

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* This movement was effected, according to Porterfield, by a contraction of the ciliary processes; or, as he termed them collectively, the *ligamentum ciliare.* Porterfield, however, knew nothing of the existence of what is now called the 'ciliary muscle.' (See his *Treatise on the Eye*, &c. 1759, vol. ii. p. 4.)

† This theory was first published by Young in 1793; but along with it he brought forward the mistaken notion that the change in the shape of the lens was owing to its possessing an inherent power of contraction, due to its being wholly made up of muscular fibres and tendons. This anatomical error had been previously advanced by Pemberton, in 1719. In 1796, Young retracted the theory he had brought forward three years before, declaring it to be 'neither new nor true,' and accepted the change of curvature in the cornea as the efficient cause of accommodation. At a later period (1800), while he abandoned the opinion that the lens was muscular, he still maintained that it possessed within itself a power of changing its form, and that by increasing its convexity, it adapted the eye to near objects. (*Phil. Trans.* 1801.)

‡ The following is Purkinje's experiment, which, before the invention of the ophthalmoscope, was frequently employed as a 'catoptric test' of the presence of incipient cataract. The patient, with his pupil dilated, is placed in the dark, and a lighted taper is then held on a level with, and at a few inches from the pupil. Three images of the flame are then perceived; one, large, distinct

The ciliary muscle is now generally believed to be the active agent in changing the shape of the lens during accommodation, but the precise mode in which the process is effected is not easy to explain. The iris also seems in some way to aid the ciliary muscle, but that the iris is not the chief agent in accommodation is proved by the fact that, in cases where it is absent from birth (*Irideremia*), or where it has been removed from the eye by an accident, accommodation seems but little impaired.

The temporary loss of accommodation in persons who have severely suffered from diphtheria illustrates the dependency of the function on some form of muscular action. In such patients, long after all their acute throat-symptoms have passed away, and they are resuming their ordinary employments, a remarkable weakness in some of the small muscles of the body becomes manifest; the palatal muscles are found to be impaired in their action, and at the same time the power of reading is lost, or it can be exercised only for a few seconds. This defect of vision is not due to any impairment of the optic nerve, for a convex glass held in front of the eye at once compensates for the loss of accommodating power, and enables the patient to read clearly.

Near and far points of distinct vision.—There is a limited range within which small objects, printing-types, for instance, can be distinctly seen by a healthy, or emmetropic, eye. If they are brought nearer to the eye than a certain point, they can no longer be recognised. This is called the 'near point of distinct vision.' If the types be moved farther off, they can still be read until they have receded to a certain distance, when they again become indistinguishable. The space comprised between these two points is called the 'range of accommodation.'

The *far-point* in an emmetropic eye is said to be 'at an infinite distance.' That is to say, rays of light from the most distant objects, the stars for instance, come to a focus upon the retina while the eye is in a state of rest. It is evident that if we use 'infinite' in its strictly etymological sense, no two things

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and upright, is reflected from the cornea; two others, much smaller than the corneal one, appear within the pupil. Of these deeper images, one, inverted, is reflected from the hinder face of the lens; the other, upright, from its front surface. If the taper be now slowly moved from side to side, the inverted image, which is always ill-defined, quits its position between the two upright images reflected from the cornea, and from the front of the lens, and glides away in a direction opposite to that in which the taper is moved.

can be at an infinite distance from each other. The word, however, is technically applied to rays which, being inappreciably divergent, are therefore treated of as if really parallel; not only such as come to us from one of the heavenly bodies, but even from an object several yards off. As some distance must be assigned respectively limiting the bounds of finite and infinite rays, twenty feet is commonly spoken of as the distance by ophthalmic writers; appreciably divergent rays, coming to the eye from an object less than twenty feet distant being called 'finite,' and those from all objects beyond that distance 'infinite.'

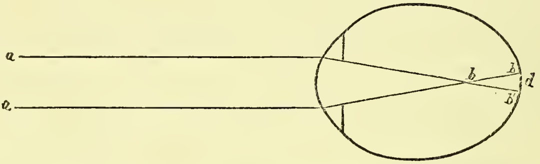
Ametropia.—The chief forms of ametropia are those popularly known as 'short-sight,' and 'long-sight.' The latter, in its true meaning, will come to be considered under the term presbyopia; but there is another form, the clear discrimination of which we owe to Donders, and to which he has given the name of 'Hypermetropia.' It is a very common affection, depending on original malformation of the eyeball, and affecting therefore persons of all ages. In short-sight (*Myopia*), parallel rays such as pass to the eye from a distant object, come to a focus in front of the retina; in Hypermetropia the rays tend to a focus behind the retina.

On the same principle of terminology which induced Donders to name this defect Hypermetropia—the sight being, as it were, ὑπέρμετρος, above the measure—short sight would be called *Hypometropia* (ὑπομετρος, below the measure); but Donders has chosen to retain the term 'Myopia' for two reasons; first because the word is established and universally accepted, and, secondly, because the similarity of sound between 'hypo' and 'hyper' would be apt to cause confusion and misunderstanding.

In *Myopia* (Fig. 141) the eye is adapted for bringing divergent rays to a focus on the retina; but parallel rays come to a focus in front of it, and then, again diverging, pass on to form upon its surface what are called 'circles of dispersion,' and thus an ill-defined image of a distant object is produced.

A concave glass, of a curvature proportioned to the degree of myopia, held in front of the eye, causes parallel rays to diverge before entering the pupil, and they are then reunited, and brought to a focus exactly upon the retinal surface (*d*). The cause of myopia consists either in the media of the eye, especially the lens, being too highly refractive, or in the eyeball itself being too long from before to behind. This elongated, ovoid form of the eye is best seen when the patient forcibly adducts it.*

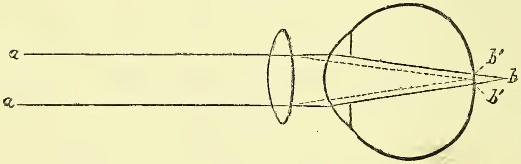
Fig. 141.



Myopic eye: too long in its antero-posterior diameter. Parallel rays, before reaching the retina, come to a focus at *b*; then, crossing, they form on the retina circles of dispersion at *b'*, *b'*.

In *Hypermetropia* (Fig. 142) the parallel or quasi-parallel rays from distant objects tend towards a focus behind the retina, while the divergent rays from near objects cannot be brought to a focus on the retina until, by artificial means, they have been made to converge. A hypermetropic patient, therefore, sees neither distant nor near things distinctly. Hypermetropia is caused either by the eyeball being too short from before to behind (Fig. 142), or by the refraction of its media being too low; or both these conditions may be combined. Convex glasses, of suitable focal length, make both distant and near objects distinct, by causing parallel and divergent rays to converge, and thus bringing them to a focus on the retinal surface.

Fig. 142.



Hypermetropic eye; too short in its antero-posterior diameter. Parallel rays, tending towards a focus at *b*, form on the retina circles of dispersion at *b'*, *b'*. Divergent rays would tend towards a focus still more distant than *b*.

Presbyopia (πρέσβυς, aged). Persons who originally have had excellent sight, both for distant and near objects (*Emme-*

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* Porterfield says: 'By myopes I understand such as have the cornea and crystalline, or either of them, too convex, or that have the distance betwixt the retina and crystalline too great.'—*A Treatise on the Eye, &c.* Edinb. 1759, ii. p. 36.

tropia), as they advance in life find that, while their distant sight is as acute as ever, near objects become more and more indistinct. Type is held farther and farther from the eyes, as the 'near point' recedes. The accomodating power has become impaired, partly by the lens acquiring greater firmness, and therefore being less able to yield to that force which ought to render it more convex when near objects are looked at; and partly from that force itself becoming weaker. A convex glass, of such a curve as will bring back the receded 'near point' to its normal position, at once renders near objects distinct.

Although a presbyopic and a hypermetropic person may both be seen using convex glasses for reading, the state of their vision is very different. The presbyopic person may have been originally emmetropic, his eyes in a state of rest bringing parallel rays to a focus on the retina, and his accommodating power, by changing the form of his lens, serving also to bring to a focus on the retina the divergent rays from near objects.

In the hypermetropic person, on the contrary, sight was always defective, both for distant and for near objects. On account of its short anterior-posterior diameter, the eye, while in a state of rest, could not receive upon the retina parallel rays; they all tended to a focus behind it, while the divergent rays from near objects could not be focussed on the retina until they had artificially been changed into convergent ones.

Presbyopia and hypermetropia, therefore, are the direct contrasts to each other. Even a myopic patient, in advanced age, will sometimes be found to a certain degree presbyopic, in consequence of the failure in accommodation which is induced by increased density in the tissue of the lens.

*Astigmatism.**—In an eye otherwise perfectly formed the cornea may be unsymmetrical, so as to present different curves accordingly as its anterior surface is measured vertically, transversely, or obliquely. The rays of light, therefore, as they fall on one or other of these meridians of the eyeball, become differently refracted, and cannot all meet at one point or focus.

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* *Astigmism* would be the more correct term, στιγμή (στιγμῆς), being commonly used by Greek writers to express a geometrical point, while στίγμα (στίγματος), always signifies something material, more or less visible or tangible —a puncture, mark, or spot. I took the liberty of pointing this out to the late eminent scholar Dr. Whewell, who had originally suggested the word 'Astigmatism,' and he approved of *Astigmism*, as being etymologically the better-formed word.

The researches of Donders and others show that astigmatism, at least in a slight degree, is by no means so uncommon as was formerly supposed. It is best detected by making the patient look at a paper on which are drawn vertical and horizontal lines of equal thickness, and noting which lines become the more clearly defined at a given distance. Young, who was himself affected with astigmatism, was the first to describe this peculiarity of vision.* He believed the cause to be in his lens, which he imagined to be placed obliquely to the axis of vision. Airy † next published an account of this condition, as affecting one of his own eyes, and he invented a glass of a peculiar form to correct the irregular refraction. Glasses of this kind are now commonly used, under the name of cylindrical or astigmatic glasses. Such a glass must be a segment of a cylinder, the axis of which is then placed before the eye vertically, transversely, or obliquely, according to the meridian of irregular refraction. For a myopic or hypermetropic patient the glass must be concavo-cylindrical or convexo-cylindrical. An instrument for determining the precise direction of the axis of a symmetry has been invented by Laurence.

I may now make a few remarks on some special points in the diagnosis and treatment of Myopia and Hypermetropia.

As I have already observed, a myopic eye is so formed as to be adapted for bringing strongly divergent rays to an exact focus on the retina; and therefore the minutest near objects are often seen with extraordinary clearness of definition, so that a 'diamond' type can be read with perfect ease at a distance of four or five inches, although at only double that distance it becomes quite illegible. As soon as the object has been removed beyond the far-point of distinct vision, the rays, after coming to a focus in front of the retina, again diverge, and form upon it the 'circles of dispersion' already alluded to. The farther the object is removed from the eye, the larger these circles become; and the patient instinctively brings the edges of his lids close together, as he finds by experience that, by thus cutting off some of the rays which would otherwise enter the pupil, the dimness caused by the circles of dispersion is diminished.

There is an endless variety in the range of accommodation among myopic patients. Some can read the smallest type at a distance of 5 or 6 inches, others only at 2 inches from the cornea. Each case must be examined and judged of by itself, for there are many complications which may prevent our always applying the same unerring rule for deciding what form of concave glass is required to neutralise the myopia. Commonly, however, we may ascertain what degree of concavity will suit for clear vision of distant objects by noting at how many inches from the cornea a small test-type can be distinctly read, and then giving the patient for distant objects a concave glass of corresponding focal length. Thus a patient who with the naked eye can define the test-type only at 5 inches is said to be myopic $\frac{1}{5}$, and a concave glass which would neutralise a convex one of 5 inches focus, and which is distinguished as —5″, will enable him to see distant objects with accuracy.

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* In the year 1800; *Phil. Trans.* 1801.

† In 1825; *Trans. of the Cambridge Phil. Soc.* vol. ii. p. 257. In his second paper, 1846 (*Trans.* viii. 361), he mentions that Whewell had suggested the name 'Astigmatism' to designate the affection.

In determining what arrangement of glasses should be made use of, the degree of myopia and the patient's general circumstances must be considered. If his sight for near objects be acute, and his amount of myopia not very great, the occasional use of a hand-glass or spectacles may be enough; but in no case should a single glass be employed. The habitual use of a glass to one eye, has in some cases a tendency to induce in the other a feebleness of vision, and a slight eversion of the eyeball. When the myopia is so considerable that type cannot be discerned unless held within 2 or 3 inches of the cornea, spectacles ought constantly to be worn.

In speaking of hypermetropia, I said (p. 6.) that, in consequence of a short antero-posterior diameter of the globe, neither parallel nor divergent rays could be brought to an exact focus on the retina. Now these are the only rays that are met with under natural conditions; or rather, as I have already observed, all luminous rays, strictly speaking, fall upon the surface of the eye with a greater or less amount of divergence. Convergence of rays is always an artificial result, caused by their transmission through a convex lens.

The unassisted hypermetropic eye, therefore, sees neither near nor distant objects distinctly; but the difficulty of seeing near and small things is so much more obvious to the patient than his inability to define distant ones, that he commonly seeks medical advice on account of difficulty in reading. To make the retinal image larger, he often brings the type near to the eye, and hence believes himself to be 'short-sighted.' But even when held near, he can only read it for a very short time, with a constant painful effort, and a sense of straining and fatigue; and when the defect exists in a very high degree, reading is altogether impossible.

The only remedy for hypermetropia is the use of convex glasses. The cause of the defect was formerly very imperfectly understood, although its results were familiar to every ophthalmic surgeon, and constituted one of the most troublesome and unsatisfactory portions of his practice. Under the vague title 'Impaired Vision,' cases of hypermetropia were treated with an endless variety of external and internal medicines, all equally fruitless.

The focal length of the lens necessary for giving such convergence to parallel and divergent rays as may suffice to bring them to a focus on the retina affords a designation for the degree of hypermetropia. Thus if a glass of 10 inches focus produces upon the retina an exactly defined image of the test-type, while distant objects are clearly seen with a glass of 30 inches, the patient is said to be hypermetropic $\frac{1}{10}$ and $\frac{1}{30}$.

As hypermetropia depends upon an original malformation of the eyeball, children affected with it must be provided with suitable spectacles, or they will be unable to read sufficiently for the common purposes of education. Donders insists on the necessity for spectacles being constantly worn by hypermetropic patients, so as to prevent over-exertion of the effort of accommodation; but we can hardly expect a school-boy to play in spectacles, however willingly he may resign himself to them as indispensable for study, and we must in most cases content ourselves with insisting on their being always used for reading, writing, drawing, &c. Adults who, although hypermetropic, have committed themselves to unsuitable occupations, involving continuous application to near objects—clerks, compositors, tailors, needlewomen—will usually be willing enough to wear spectacles at all times. In some cases one pair of glasses will suffice, in others more convex lenses will be needed for near objects, and less convex ones for distance.

Test-types.—It is evident that in examining a patient's sight some definite tests must be selected, and printing-types are the best and most convenient objects. As freer intercourse was established between different countries, it became more and more desirable that some uniform standard of reading-tests should

TEST TYPES:

Corresponding in size to the ‘Schrift-Scalen’ of Professor Jæger. (1860.)

No. 1.

First, I was to prepare more land, for I had now seed enough to sow above an acre of ground. Before I did this, I had a week's work at least, to make me a spade, which, when it was done, was but a sorry one indeed, and very heavy, and required double labour to work with it. However, I went through that, and sowed my seed in two large flat pieces of

No. 3.

ground, as near my house as I could find them to my mind, and fenced them in with a good hedge, the stakes of which were all cut of that wood which I had set before,

No. 5.

and knew it would grow; so that in one year's time I knew I should have a quick or living hedge, that would want but little repair. This

No. 6.

work was not so little as to take me up less than three months, because a great part of that time was of the wet

No. 8.

season, when I could not go abroad. Within doors, that is when it rained and I could not go

No. 10.

out, I found employment on the following occasions ; always observing that, all the

No. 12.

while I was at work, I diverted myself with talking to my parrot,

No. 14.

teaching him to speak. I quickly taught him

No. 15.

to know his own
name, and at last

No. 16.

to speak it out
pretty loud 'Poll,'

No. 18.

it was the
first word

No. 19.

I ever

No. 20.

heard

be agreed upon, so as to enable ophthalmic surgeons to understand the reports of each other's cases. The sizes of printing-types, however, are not everywhere the same, and persons are usually unacquainted even with the typographical terms of their own country—*pearl, minion, brevier, bourgeois, pica,* &c.—unless they happen to have had some practical experience as authors. When, therefore, E. Jæger published in 1854 a series of printed tests, the letters of which were distinguished by numbers instead of by technical names, they were generally accepted by the profession, and referred to in reporting cases. More recently Snellen has devised a special form of type, in which the letters are all drawn on a regularly proportioned scale of thickness of stroke.* In doing this, he has acted on the following principle. If the eye be taken as a centre, and from it a circle be described of 12 inches in diameter, a well-illuminated object occupying only $\frac{1}{60}$ of a degree in this circle can be recognised. In other words, certain objects, the size of which is about $\frac{1}{600}$ of an inch, can be seen by an emmetropic eye, at a distance of 6 inches. Such objects, however, as printing-types cannot be distinctly perceived at a smaller visual angle than about five minutes of a degree. Snellen's letters, therefore, are uniformly drawn in lines the thickness of which is equal to one-fifth of the whole letter, so that, while a letter occupies five minutes of the field of vision, each line composing the letter would occupy a space of only one minute. Each size of Snellen's type is distinguished by a figure, indicating the number of feet at which the letters ought to be legible to an emmetropic eye. In a second edition of his test-types (1864) Snellen printed some tables of 'test-dots,' which may be used by persons who cannot read. These dots had been contrived by the British army authorities for determining the acuteness of vision in recruits.

No doubt the principles on which Snellen's letters are formed are more scientific than those which regulate Jæger's, and are to be preferred in cases where optical experiments are made on intelligent and educated persons. But those of limited reading powers, especially in hospital practice, are often puzzled by the unusual forms used by Snellen, and cannot read them fluently, even when quite able to read the ordinary type they are accustomed to in books and newspapers.

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* It is only with letters of a certain size, however, that Snellen has carried this plan into effect. The larger letters are all drawn on the principle he lays down, but his letters No. 1, No. 2, and No. 3, are all printed from ordinary thick and thin metallic types. (*Test-types for the Determination of the Acuteness of Vision,* 3rd edit. 1866.)

CHAPTER II.

EXAMINATION OF THE EYE.

Superficial Examination.

The Conjunctiva and Cornea.—For examining the former of these structures, when attacked with the slighter forms of ophthalmia, no special manipulations are required. The ocular portion is open to the surgeon's observation, and, to explore the lining of the lower lid, it is only necessary to depress the tarsus with the point of the finger. It is often difficult, however, to obtain a satisfactory view of the cornea in a child suffering from that irritable form of inflammation commonly known as *Scrofulous Ophthalmia*, but more correctly called *Keratitis.* The surgeon does but waste his time who attempts to coax or parley with such a patient. Light causes so much pain, that the child makes every effort to exclude it, by keeping the eyelids firmly pressed together, and even, in severe cases, thrusting his face against the pillow, or the dress of the attendant.

The surgeon should sit, and spread a folded towel across his knees. Opposite to him sits the attendant, who secures the child's hands, and lowers him backwards until his head is received between the surgeon's knees, and there firmly held. Thoroughly to expose the cornea without everting the lids requires tact, which practice alone can give. The extreme tip of the fore-finger, with a bit of rag twisted over it to prevent slipping, having been laid upon the middle of the upper tarsus, at the very edge—between the roots of the eyelashes and the globe—the lid, without any dragging of the skin, is to be steadily pushed in a direction which, in the erect position of the body, would be upwards and backwards. In this way the greater part of the cornea is at once exposed; but if the finger is allowed to drag the skin of the lid, the tarsal cartilage instantly becomes tilted over, and the swollen conjunctiva, bulging forwards, hides the eyeball from view. By a similar manœuvre the lower lid may be depressed; but this is not necessary in examining the cornea, for that part is always rolled upwards to seek the shelter of the upper lid.

If a more prolonged examination of the eyeball be required, as in a case of *Ophthalmia neonatorum*, a spring speculum must be employed, adapted, as regards width and strength of spring, to the small size of the palpebral fissure.

To expose the conjunctiva of the upper lid, the part must be everted, as if the surgeon were in search of a foreign body; and, indeed, it is with such an object that the eversion is most frequently performed. Whenever a patient complains of having had a fragment of anything blown into the eye, and a careful scrutiny of the edges of the tarsi, the fold of the lower lid, and the surface of the globe, has failed to reveal the cause of irritation, the upper lid should be treated in the following manner:—A pen, the extreme feather end of which is cut off, so as to leave a stem just thick enough to resist bending, is laid across the upper lid, about half an inch from its free margin; then, while the finger and thumb of the other hand grasp the eyelashes growing from the middle of the lid, the pen is pressed a little downwards, at the same moment that the lid is drawn first a little forwards, and then upwards; the tarsus will suddenly tilt and fold over, so as to expose its conjunctival surface.

This manœuvre, simple as from description it seems to be, requires a good deal of *knack*. Both hands must act together, and if at the moment the turn is being given to the lid, the patient is told to look downwards, the eversion is much more readily accomplished. Minute foreign bodies, which have fixed themselves beneath the upper lid, are almost invariably found very near its tarsal margin; they should be lightly picked off with the feather or nib of the pen used for effecting the eversion. A pen is not only more convenient than a probe, but it has the advantage of appearing less formidable to a timid patient.

Lens and iris.—Great care is required in examining a patient in whom we have reason to suspect that Cataract is commencing. The first faint streaks of opacity in a lens will often escape detection, unless light be concentrated on the part by means of a convex glass of about an inch focus. I need hardly say that in all daylight examinations of the eye, the direct rays of the sun are to be avoided. The observer must also take care that light does not fall upon the cornea from more than one window;

and that reflections from mirrors and other polished surfaces do not interfere with the single ray of direct light which should fall on the part to be examined. No lens can be fully seen until the pupil has been widely dilated with atropine; but inasmuch as this dilatation alters the visual condition of the eye, all particulars as to the patient's range and distinctness of sight should be noted before the atropine is applied.

In the very earliest stages of Cataract, examination by daylight, even when the light is concentrated by a convex glass, may sometimes fail to detect alteration in the lens. Neither can this be made out with the ophthalmoscope. But if in a darkened room the rays of a flame be thrown sideways upon the lens, by means of a convex glass, and the part be then carefully scrutinised with the naked eye, highly refractive dots, like minute oil-globules—which probably they really are—will be found scattered throughout the substance of the lens, the fibres of which also are now made visible as delicate radiating lines.

The contractility of the iris is tested by placing the hand close to the eye for a second or two, and then quickly withdrawing it, so as to allow the light to fall suddenly upon the pupil, the other eye meantime being closed. The sympathy between the two eyes should next be examined, by observing how far light admitted to one eye influences the iris of the other.

This separate examination of each eye is a very important point, for cases occur in which, while one eye is sound, the other is so utterly blind as to have lost all perception of light, yet the pupil of this blind eye will contract as soon as light is admitted to the sound one. An extensive adhesion between the edge of the pupil and the capsule of the lens (*Synechia posterior*) would at once attract notice; but if any slight deviation from the healthy round form of the pupil exists, its margin must be carefully examined, to see if any very small adhesion be the cause of such irregularity. A very slight synechia often affords a valuable hint towards diagnosis, as proving that iritis must at some period or other have attacked the eye. Whenever the surgeon is in doubt as to the existence of adhesions, the application of atropine will determine the question.

It should ever be borne in mind that a dilated and inactive pupil by no means necessarily implies that the retina is diseased; nor an active pupil that the retina is sound. If one pupil be large and immovable, and the sight of that eye dim, the patient should be made to look at type through a large pin-hole in a card held close to the cornea. The object of this will be explained under the head 'Mydriasis.'

We must never be satisfied with a patient's vaguely telling us that he can or cannot read; we must have a precise and definite standard, such as is afforded by his reading to us aloud from type of several sizes. In hospital practice, those who have not learned their letters—who, as they express it, are 'no scholars'—may be told to count small dots, point out a single and a double line, or select an asterisk from other typographical marks. This subject has been more fully treated under the head of 'Optical Defects.'

The simple modes of examination hitherto mentioned have at all times been at the surgeon's command; I come now to consider the use of an apparatus—the *Ophthalmoscope*—the invention of which has enabled us to explore those deeply-seated structures previously altogether beyond the range of observation.*

OPHTHALMOSCOPIC EXAMINATION.

It is little more than twenty years since Cumming † first demonstrated that, by a certain arrangement of light, the fundus of the healthy human eye could be made visible, so far at least as to allow of its colour being seen. Although he never obtained a view of the optic nerve or vessels of the retina, his investigations prepared the way for the discovery of the ophthalmoscope, by proving that the fundus of the living eye was not really a dark-coloured surface; but that under certain conditions it reflected the rays of light falling upon it, so as to present a brilliant surface to the eye of the observer. An indistinct reddish gleam from the retina, or a white reflection from the optic nerve, had been sometimes accidentally seen by those engaged in the study of eye-diseases; but they had regarded these glimpses of the fundus of the eye as exceptional, and as indicating something morbid in the deep tissues. Thus, in certain cases of impaired sight, with dilatation of the pupil, Beer had observed a peculiar luminous appearance, which he assumed to be the result of some morbid change in the retina; and he accordingly made use of the term 'cat's-eye amaurosis' to designate the disease which he supposed to give rise to this luminous appearance. Other observers had attributed it to a deficiency of pigment, still assuming that, in a state of health, the fundus of the eye must necessarily appear black.

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* In the first edition of the present Essay there was no special section on the Examination of the Eye. In now adding a preliminary chapter on the subject, I have here and there made use of a paragraph from my little volume on *Eye Diseases*. When I have had to repeat former statements, I have not thought it necessary to vary the wording merely for the sake of giving an air of novelty to some commonplace directions.

† *Medico-Chirurgical Transactions*, 1846.

The first ophthalmoscope was invented by Helmholtz, and described by him in a tract published in 1851.* He began by showing in how simple a manner, by using a slip of glass, the surface of the retina might be made visible; and then constructed an apparatus of several superimposed glass plates, with which he obtained a more perfect view of it. These first examinations were made without any artificial dilatation of the pupil, so that only a limited extent of the retina could be seen. He was able, however, to distinguish the optic nerve, and the vessels emerging from it.

In 1852 Ruete † invented an ophthalmoscope on a different principle from that of Helmholtz, light being thrown into the patient's eye by means of a concave mirror, through a hole in the centre of which the observer looked directly upon the illuminated retina. The practical objection to Ruete's instrument consisted in its being fixed to a stand, and therefore ill adapted to observe an organ so frequently in motion as the eye. Coccius ‡ avoided this inconvenience by constructing a small perforated mirror, to be held in the hand; and this instrument was still further modified by Anagnostakis,§ whose ophthalmoscope, from its extreme simplicity, appears to me one of the most useful that has yet been invented, and quite the best for the student to begin with. It consists of a circular glass mirror about an inch and three-quarters in diameter, slightly concave, and perforated in the centre with a round hole, the tenth of an inch wide. The mirror is set in a metal frame, to which a handle is fixed. Liebreich's instrument is made, not of glass but of polished metal, with a focus of from four to six inches. One of the advantages of the metallic mirror is that the edge of the aperture can be made quite thin, whereas the glass mirror must be backed by a plate of metal, and by drilling through this, and through the thickness of the glass, the aperture really becomes a short tube. Any reflection from the wall of this tubular aperture must be prevented, by carefully covering it with a dead black coating. At the back of Liebreich's instrument there is a little hinged clip for holding a convex or concave glass against the sight-hole. The concave glass is necessary in making an examination by the 'direct' method, if the patient or the observer be myopic.

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* *Beschreibung eines Augenspiegels zur Untersuchung der Netzhaut im lebenden Auge*, Berlin.

† *Der Augenspiegel und das Optometer*, Göttingen.

‡ *Ueber die Anwendung des Augenspiegels*, Leipzig, 1853.

§ *Essai sur l'Exploration de la Rétine et des Milieux de l'Œil sur le Vivant*, Paris, 1854.

There are various forms of the ophthalmoscope which, in the hands of practised observers, will afford a good view of the fundus of the eye, but it is well for the student to begin with the simplest kind; those, for instance, which I have just mentioned. When habit has given dexterity in the combined management of the mirror and object-lens, the *binocular* ophthalmoscope, as invented by Giraud-Teulon, or some improved form of it, may be employed.

Before commencing a thorough examination of a case, it is necessary to dilate the pupil with atropine, unless it has become permanently dilated from disease. In many instances, however, a glance at the optic nerve and the parts adjacent is all that is required, and in that case it is unnecessary to subject the patient to the inconvenience of atropine.

The observer and the patient sit face to face in a room from which daylight is excluded; the only source of illumination being a lamp, or, still better, a jet of gas issuing from a jointed tube, so that the flame can be placed higher or lower, according to the height of the patient's head. The flame should be on a level with his eye, and just far enough behind him to prevent any of the direct rays falling on his cornea. The chimney surrounding the flame must be of transparent glass, and, if faintly tinged with blue, it will modify the red rays, and impart to them a whiteness nearly resembling that of ordinary daylight. The observer places the back of the mirror close to his own eye, so that he looks through the central aperture, and holds the instrument at such an angle that the reflected light from it falls into the patient's pupil. This is always very difficult for a beginner to accomplish, but a little practice soon makes it easy. He will know that he holds the instrument in the right position and at a proper distance from the eye, by seeing the fundus assume a brilliant reddish appearance.

Still holding the ophthalmoscope in the same position, he takes in the other hand a convex glass, of two inches or two inches and a half focus, and places it a little in front of the cornea. If the fundus of the eye be properly illuminated, and the convex glass correctly placed, some of the retinal vessels will now be distinctly seen. The observer is often confused by seeing a small bright image of the mirror reflected from the surface of the object-lens. This image can be got rid of by giving to the lens a slight inclination.

By turning the eye in various directions every portion of the retina is successively brought under the view of the observer. The necessity for varying the position of the eye constitutes a great objection to the more complicated ophthalmoscopes, which are fixed to a table or other support; and some eyes are so unsteady, and so little under the patient's control, that the observer is obliged to follow their movements by slight changes in the position of the ophthalmoscope, which can only be effected when the instrument is held in the hand.

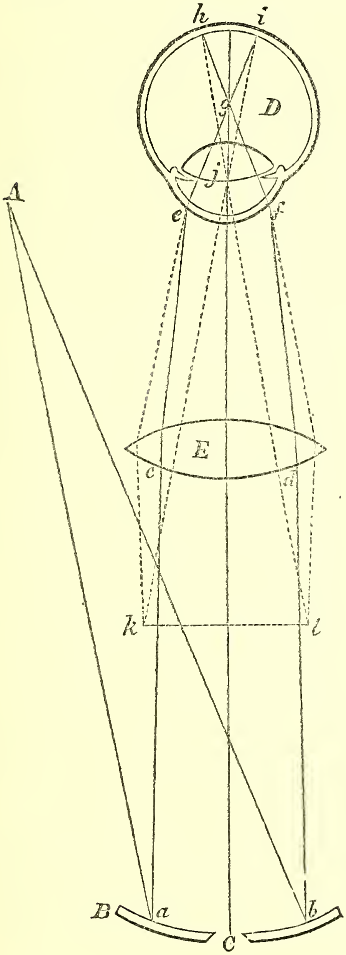
There are two methods of examining with the ophthalmoscope—the 'direct,' and the 'indirect.' In the former method, the mirror must be brought very close to the patient's eye—an inch or two from the cornea—and the image of the retina then appears to the observer in its natural *erect* position. But this very close approximation to the patient is inconvenient; the side of the patient's head intercepts some of the light which ought to fall on the mirror; and only a limited portion of the retina, thus feebly illuminated, can be brought into view at one time. The direct method, therefore, is comparatively seldom employed, and chiefly for the purpose of examining in detail small portions of the fundus, which are seen in their true position, and considerably magnified.

In the 'indirect' method, the mirror is held at a distance of several inches from the patient's eye, and a convex lens of short focus, two to two and a half inches, is placed a little in front of the cornea. In this way the inconvenient and obviously undesirable relative position of the observer and observed is avoided, the retina is more brilliantly illuminated than in the 'direct' method, and a good general view of the whole fundus is obtained. The image of the retina seen by the observer is an 'aërial' one, which is formed at a point between the convex lens and the ophthalmoscope, appearing there in an *inverted* position. This inversion of the parts examined must always be borne in mind by the surgeon while employing the 'indirect' method.

The following diagram, copied from Zander's work, explains the mode in which the aërial inverted image is formed.

Within the narrow limits of the present essay, I cannot

Fig. 143.



A is the illuminating flame; *B* the concave speculum; *C* the aperture in its centre; *D* the patient's eye, before which is held a convex lens, *E*. From the flame *A* the rays *a b* fall on the speculum, and are reflected from it towards *D*. Striking the lens, *E*, at *c* and *d*, they acquire a greater convergence in passing through it, and fall upon the cornea at *e* and *f*. Traversing the patient's eye, they again converge, and, intersecting at *g*, form on the retina a 'circle of dispersion,' at *h i*. Reflected from the retina, in the direction of the dotted lines, *k*, *j*, *i*, *j*, they pass out of the eye, and being intercepted by the lens *E*, are again refracted, and form at *k l* an inverted image of the retinal surface *h i*, which is viewed by the observer's eye placed at *C*.

attempt to give more than a bare outline of the use of the ophthalmoscope. The literature of the subject is already overwhelming. One of the most complete treatises is that by Zander, just alluded to, *Der Augenspiegel*; Leipzig, 1859. It has been translated, and has undergone considerable condensation—

a process it greatly needed—by Carter, under the title of *The Ophthalmoscope, its Varieties and its Use*; 1864. There is also an excellent essay in French by Giraud-Teulon, contributed by him to the supplemental volume of Testelin's and Warlomont's translation of Mackenzie's great work.

Ophthalmoscopic Appearances of the Eye in a healthy state.
(Plate I. fig. 1.)

In the heading of this section I use the word 'healthy' with a certain latitude of meaning; for, apart from any serious disease, the mere advance of age imprints upon the internal tissues of the eye, certain changes of appearance, which, although deviating from an ideal standard of perfect health, can hardly be termed morbid. At present, I wish to present to the reader merely a sketch of what he is to look for in an eye which fairly performs its functions as an organ of vision.

Retina.—The observer must not expect to find this tissue presenting one uniform colour in all cases; the tint varies from pale red, through shades of red-orange and yellow-orange, to buff. In full-blooded persons, with a vigorous circulation, the retina would naturally have a much redder appearance than in those who are feeble and anæmic.* The colour of the retina is almost wholly due to the vascular choroid behind it; and the amount of redness transmitted from the choroid will depend upon the quantity and condition of the hexagonal pigment between it and the retina. Some ophthalmoscopists altogether object to our speaking of the colour of the retina, inasmuch as owing to its translucency, it allows the redness of the choroid to be seen. But no objection ought surely to be taken on this account to our familiarly applying the term colour to the retina itself.

Across the illuminated fundus of the eye the observer will notice large vessels radiating from a central point towards the periphery. These are the large branches of the central artery and vein of the retina; and by directing the patient to turn the eye a little towards the median plane, the observer will be able to trace these vessels to their parent trunks in the middle of the optic nerve. The vessels of the choroid, as I shall by-and-by have occasion to notice, are so entirely unlike the radiating trunks of the retina, that a single examination will suffice to prevent any subsequent confusion between them.

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* These remarks apply only to patients as commonly seen in England. Among the darker tribes of mankind, the abundance of pigment gives to the fundus of the eye, both in health and in disease, shades of colour wholly different from those of the fairer races. For ophthalmoscopic appearances among the natives of India, see Macnamara's *Lectures on Diseases of the Eye*, 1866.

It requires a little more practice to distinguish between the retinal arteries and the veins. If an arterial trunk be examined where it attains its greatest size, namely, at its emergence from the optic nerve, it will be seen to be of a paler red colour than the adjacent vein, and to present a double outline. The greater thickness of the arterial wall is the cause of both these peculiarities of appearance; for, of course, the colour of the contained blood is less plainly seen where the wall is thicker; and while the light, reflected from behind the artery, shines through it with subdued brightness, each side of the cylinder presents a line of shadow. The coats of the veins, on the other hand, are so thin, that they allow the colour of the blood to be plainly seen throughout the whole diameter of the tube. This distinction between the veins and the arteries of the retina becomes less marked as age advances. Simple inspection of a healthy eye does not detect any pulsation in the retinal vessels; but if the globe is firmly pressed with the finger, a decided pulsation may be seen, both in the arteries and veins.

If the patient looks directly forwards, a very important portion of the retina comes into view, namely, that occupied by the *macula lutea*, or 'yellow spot,' which corresponds to the axis of vision. The retinal arteries and veins deviate a little from their regularly radiating course as they approach the yellow spot, which therefore has no large vessel in its immediate neighbourhood. (Plate I. fig. 1.) Most observers, I think, must content themselves with making out the cloudy redness which indicates the position of the *macula lutea*, without actually seeing the dot which it forms. Liebreich gives a drawing (tab. ii. fig. 1) in which it is represented. I have, however, never succeeded in obtaining such a view of it as he depicts.

Optic nerve.—To bring the nerve into view, the patient must direct the eye a little towards the nose. No structure seen with the ophthalmoscope presents a greater variety of appearance than the optic nerve, even in patients who enjoy good sight. As age advances it becomes smaller, and often deviates more or less from that circular outline which one may assume as the healthy standard.*

Contrasted with the reddish tint of the surrounding retina, the nerve appears cream-coloured, or it sometimes presents that faint tinge of pinkish-grey which we are familiar with in the cineritious portion of the cerebral convolutions. The extreme edge of the disk is often of a less decided white than the central portion.

From the centre of the nerve the main trunks of the retinal artery and vein are seen emerging. Commonly each vessel issues as a single trunk, which then divides into branches, but sometimes the division into two or three trunks takes place before the vessels quit the substance of the nerve in which they are imbedded. In some cases the vessels pass off at once to their destination, in nearly straight, or slightly wavy lines, while in other cases they form several abrupt curves on the surface of the nerve before quitting it.

Choroid.—This structure exhibits a great variety of appearances under the ophthalmoscope. The distinctness with which it is seen depends upon the degree of transparency of the retina, and the condition of the hexagonal pigment-cells behind it; and it seems that considerable variations in both these tissues are compatible with good sight.

In young persons the vessels of the choroid appear dim and indistinct, as if overspread with a thin semi-opaque film; but in old persons they are sometimes so plainly seen that the observer almost forgets he is looking at them through the whole substance of the retina. It is in old persons, therefore, that the peculiar arrangement of the choroidal vessels can be best studied. They are very much larger than the radiating vessels of the retina, and are closely packed together, leaving between them narrow, elongated spaces, in which dark pigment is visible. (Plate III. fig. 1.) During the earlier periods of life these vessels present a bright red, but in old age this colour often becomes mixed with a brownish tint.

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* I have uniformly spoken of the *optic nerve,* instead of using the term 'optic papilla,' which some authors employ. No confusion can arise from applying the term *nerve* to that which is in reality only a part of the nerve, since no other portion than its extremity comes under our notice in using the ophthalmoscope. The term 'papilla' is objectionable too, as implying a *prominence*; and I believe the distal end of the optic nerve to be nearly, if not quite plane in a state of health.

CHAPTER III.

DISEASES OF THE CONJUNCTIVA AND ITS AREOLAR TISSUE.

(*Ophthalmia* ; *Conjunctivitis.*)

Inflammation of the conjunctiva, I need hardly say, accompanies many of the inflammatory processes originating in other tissues of the eyeball. In the present chapter I confine myself to those cases in which the inflammation originates in the conjunctiva, and is either limited to it, or spreads only to the sclerotic.

Inflammatory redness differs very remarkably in these two structures. It is on the inner surface of the lids, and at their point of junction with the globe, that the conjunctival vessels are largest, and their redness is most strongly marked ; and the colour becomes paler as the vessels diminish in size on approaching the cornea. The sclerotic vessels, on the contrary, are most visible close to the cornea, around which they form a pink circle, known as the *sclerotic zone*—a very characteristic mark of several important forms of disease in the deep-seated tissues of the eye. Even if the sclerotic be uniformly injected throughout its whole extent, this injection cannot be traced very far back from the edge of the cornea, because the redness soon becomes hidden beneath the fibrous insertions of the recti muscles. The vessels of the sclerotic are small, closely set together, and so interlaced with the proper fibres of the part that the individual trunks cannot be recognised ; they merely produce the effect of a uniform tint of colour, nearly resembling that of carmine. The conjunctival vessels, for the most part, are plainly seen, and, except in that high stage of inflammation termed *chemosis*, they can be observed repeatedly to anastomose, so as to form a closely-set network.

Elaborate classifications of the various forms of ophthalmia are to be found in many of the systematic works on eye-diseases ; but minute distinctions, however plausible they may look on paper, are of little or no use to the practitioner. In selecting a few heads, under which to group the varieties of ophthalmia, I have been guided by the very decided peculiarities which certain forms present, or by the marked difference in the treatment they require. Most of the slighter forms of conjunctival redness, not resulting from direct violence or the presence of foreign bodies, are due to atmospheric changes; and the cases described by authors under the name *simple ophthalmia*, are, for the most part, mild cases of catarrhal inflammation. When the sclerotic also is affected, the term *rheumatic* is sometimes added; and Mackenzie uses the words 'catarrho-rheumatic' to signify that both the conjunctiva and the sclerotic are inflamed, although the inflammation may be due to the mere external agency of cold, and not to the presence of rheumatic poison in the blood of the patient.

Slight attacks of redness of the conjunctiva are commonly attended with only trifling uneasiness. The enlarged vessels, projecting above the level of the membrane, suggest to the patient the notion of foreign bodies, sand or dust, between the lids and the globe. But in other instances, where the redness is very trifling, the pain is of a neuralgic character, and it is for the irritation existing in the ophthalmic division of the fifth nerve that the patient seeks medical aid. It is important for the practitioner to remember that in such cases the suffering may be really severe, although there is far less appearance of inflammation than in other cases where pain can hardly be said to exist.

Whenever a case of ophthalmia is seen for the first time, the margins of the lids and the puncta lacrymalia should be carefully explored, as a few irregular eyelashes, or even a single eyelash lodged in one of the puncta, may be causing the irritation.

It sometimes happens that a foreign body, lodged under the upper lid, sets up a considerable amount of ophthalmia, and yet the patient is not aware of any such cause of irritation being present. To evert the lid requires a certain amount of tact and practice. A probe, or the feather-end of a pen, just thick enough to resist bending, is to be laid horizontally across the lid, about half an inch from its free margin. The surgeon then grasps with his finger and thumb the eyelashes growing from the middle of the tarsus, and draws the lid away from the globe, while at the same moment he slightly depresses the probe or pen, and tells the patient to look downwards. The tarsal cartilage tilts over, and the conjunctival surface of the lid is exposed to view. The foreign body is almost invariably found within a line or two of the tarsal margin.

This simple eversion of the lid appears so obvious a method of detecting foreign bodies, that one fancies it must have suggested itself to surgeons from the very earliest period; and yet, as far as I can discover, it was for the first time made public by Ware, in 1787.*

When the surgeon has satisfied himself that the redness of the conjunctiva is not caused or kept up by any mechanical irritation, he is not at once to prescribe a lotion or drops as a mere matter of routine. I shall hereafter have occasion to speak of the invaluable properties of a local stimulant in cases of true *catarrhal ophthalmia*; but at present I am considering those varying forms of conjunctival redness which are described by most writers under the name of *simple ophthalmia.* It is the surgeon's business to note well the general aspect of the patient: to ascertain what is faulty in respect of digestion, general nervous power, condition of the circulation; whether the ophthalmia can be traced to over-use of the eyes, exposure to irritating or vitiated air, want of exercise, excess in the use of stimulants, tobacco, &c.; in short, a rapid survey is to be taken of whatever is faulty in the patient's general health, and, in most cases, when this has been done, and the proper medical and dietetic means have been taken to correct what is amiss, the ophthalmia is already in a fair way of being cured.

As a rule, local congestion of the conjunctival vessels is met with in feeble and languid patients, who require tonics—iron, or quinine, or mineral acids, and a corresponding plan of diet. Of course there are many cases in which an excess of stimulants, and general over-feeding, have disturbed the due balance of the patient's circulation, and where a restricted and well-regulated diet is absolutely essential. But even in such cases a careful and moderate use of tonics is often necessary. What I wish to guard my readers against is the habit, which has been handed down to us from early times, of regarding all inflammations of the eye as necessarily to be treated by depletion, leeches, and low diet. The very reverse of this is the truth. The popular notion that a leech or two to the temples, and a purgative, must needs cut short an attack of inflammation in the eye is shared by only too many of the old school of practitioners. In young children especially such treatment is most mischievous. From the age of one or two years up to puberty, ulceration of the cornea is what we have most to fear, and this is sometimes attended with so slight a degree of redness of the conjunctiva and sclerotic, that it is important for the surgeon to be aware of this fact, and not to overlook slight attacks of ophthalmia in such subjects, but in every case to look carefully to the condition of the cornea.

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* *Remarks on the Ophthalmy*, &c. p. 23.—I have thought it well to repeat, in this place, directions already given under another head, at p. 17.

While I so strongly insist on the great importance of general treatment in ophthalmia, I by no means exclude the use of local remedies. Where much intolerance of light exists, a small blister to the temple, or the application of tincture of iodine to the skin of the upper lid, will often afford great and immediate relief. Bathing the eyes night and morning with warm water is of great use in some irritable patients; while, in other cases the use of cold water is indicated. Those persons especially who have induced a congested state of the conjunctival vessels by prolonged exposure to artificial light, are often greatly relieved by a plentiful sluicing of the closed lids with cold water night and morning. Where there is agglutination of the lids during sleep, a little spermaceti, or perfectly fresh olive-oil, may be smeared on the eyelashes at bedtime. Weak solutions of acetate of lead or alum (two, three, or four grains to an ounce of distilled water) are useful in chronic cases; but they should be used sparingly, and never for too long a time. After a few days they should be left off, and the part allowed to recover its natural tone, the stimulant being resumed if necessary; but it should never be uninterruptedly continued for weeks or even months, as patients are only too fond of doing.

There are certain forms of ophthalmia which present such distinctive characteristics that they are very properly known by special names. Such are the *Catarrhal*, the *Purulent* (including the *Infantile* and the *Gonorrhœal* forms), the *Pustular*, and the *Chronic*. The disease commonly termed *Scrofulous Ophthalmia* should rather be classed among the diseases of the cornea; and the same may be said of the *Exanthematous* ophthalmia of authors; for it is the cornea which chiefly suffers, either by ulceration or sloughing, in consequence of the low state of vitality following the various forms of exanthematous disease. The term chronic, although of course applicable to any slow and protracted form of disease, when applied to ophthalmia is usually understood to mean an affection of the palpebral conjunctiva, the caruncle and semilunar fold, and the margin of the lids, which is either developed as an independent disease, or remains as a sequela of an acute attack of catarrhal or purulent inflammation.

Catarrhal Ophthalmia.

This is commonly caused by exposure to draughts of cold air, but it is by no means limited to the cold season of the year. It frequently attacks large numbers of persons during the extreme heat of July or August, especially if, as often happens, an east wind prevails at the same time.

A well-marked case of catarrhal ophthalmia presents the following appearances: the cornea is quite clear, and vision is unimpaired, or only occasionally obstructed by the passage of thickened mucus across the area of the pupil. The conjunctiva of the lids is redder than natural, and the injection is particularly marked at the point of reflection of the conjunctiva from the lower lid to the globe. The semilunar fold and caruncle are red and much swollen, especially the former, and this enlargement of the semilunar fold often remains long after all other traces of the ophthalmia have subsided. The surface of the globe presents a network of vessels which gradually becomes less marked as it approaches the cornea. In some cases the sclerotic is involved, and then the peculiar pink zone is seen reaching close up to the margin of the cornea.

A peculiar characteristic of true catarrhal ophthalmia is the existence of numerous red blotches at various parts of the network of vessels, caused by some of these having given way and allowed their blood to become extravasated. The extravasations vary much in size; some are as small as a pin's head, others almost equal the breadth of the cornea.

At the commencement of the attack there is little increase of secretion; subsequently, mucous secretion sets in, which in some cases becomes so profuse as to make the surgeon suspect that the case may be one of true purulent ophthalmia.

There is usually no acute pain in common catarrhal inflammation; but a sense of weight and stiffness in the lids, and, as the disease advances, the enlargement of the vessels suggests to the patient the notion of sand or some other foreign substance between the lids and the globe.

When the sclerotic is much involved, there is usually intolerance of light, and much secretion of tears, and pain either of a dull aching or of an acute darting character. The upper lid, too, frequently becomes œdematous in cases of this mixed kind of sclerotic and conjunctival inflammation, and the infiltration of the subconjunctival cellular tissue raises the conjunctiva above the level of the cornea, so as even sometimes to overlap its margin. This elevated condition of the inflamed conjunctiva is termed *Chemosis.*

I need hardly say that a patient who is the subject of catarrhal ophthalmia is frequently disordered in general health, with confined bowels and disturbed digestive functions, and may require appropriate treatment by internal medicines; but very often the ophthalmia comes on without any general ailment, and seems a purely local affection, even limiting itself in some instances to one eye.

Treatment.—When the ophthalmia is unattended with constitutional disturbance, and is confined to the conjunctiva, the local application of nitrate of silver in solution may be regarded almost as a specific. It should be used in the proportion of two grains to the ounce of distilled water, and dropped upon the surface of the eye twice or thrice a day, the conjunctiva being cleansed, by bathing it with warm water, before each application of the drops. At bedtime the eyelashes should be anointed with a little spermaceti-ointment or olive-oil. Care must be taken not to continue the use of the drops too long. After being used for a week, they may be omitted for a couple of days, and then resumed as before, if the inflammation appears unsubdued; but often it will be sufficient, after a week's application as above described, to use the drops for a few days longer once a day. In uncomplicated cases, ten days or a fortnight will suffice for the cure; but, if the disease spreads to the sclerotic and cornea, the nitrate of silver must be omitted. The caruncle and semilunar fold are the last to recover their healthy condition after an attack of catarrhal ophthalmia. I have said that the treatment by nitrate of silver is to be adopted when the inflammation is *limited to the conjunctiva*; and it is from want of attention to this point that so much mischief is constantly done. Whenever the sclerotic is much inflamed, and, still more, whenever the cornea is in the least degree implicated, nitrate of silver does nothing but harm.

PUSTULAR OPHTHALMIA.

This is a very common form of ophthalmia, especially among children and young persons. It is characterised by little, reddish,* aphtha-like elevations on the conjunctiva, close to the edge of the cornea, each surrounded by a plexus of blood-vessels. The centre of the little elevations is less vascular, and therefore whiter, than the base, and hence their appearance is a good deal like that of a pustule; but they do not contain pus, and the term 'papular ophthalmia' would be more appropriate than 'pustular.' When only one or two of these so-called 'pustules' are present, they are usually found upon the equator of the eyeball; but sometimes they are more numerous, and almost surround the cornea. They are seldom attended with much pain, or intolerance of light, unless the sclerotic be also inflamed. In true pustular ophthalmia the cornea never suffers, although, from the redness extending close up to its margin, patients are often alarmed at the prospect of the disease affecting the sight.

Vascular elevations similar to those of common pustular ophthalmia sometimes accompany the irritable form of corneal inflammation improperly termed 'Scrofulous Ophthalmia.' In such cases the intolerance of light may be very great.

Unless there be some derangement of the general health, the treatment of pustular ophthalmia is very simple. A weak solution of acetate of lead—two, three, or four grains to the ounce of distilled water—may be used twice or thrice a day; or, if the inflammation be extensive, and the 'pustules' numerous, a blister to the temple should be applied before the lotion is resorted to.

PURULENT OPHTHALMIA.

(*Suppurative Ophthalmia; Ophthalmo-blenorrhœa; Conjunctivitis puro-mucosa; Ophthalmia contagiosa; Egyptian Ophthalmia; Ophthalmia bellica; Military Ophthalmia.*)

On arriving at the consideration of this form of ophthalmia, we must no longer confine our attention to the conjunctiva; for although it is in this tissue that the disease commences, it derives all its importance from the fact that the *cornea* is liable to become involved. Much has been written upon the essential differences subsisting between the common purulent ophthalmia of adults, that affecting infants, the Egyptian, and the gonorrhœal ophthalmia; but these various forms, in certain stages of their progress, often resemble each other very closely, so that a severe case of common purulent ophthalmia cannot be distinguished from one of gonorrhœal origin: and the purulent secretion from the eye of an infant suffering from *ophthalmia neonatorum*, if applied to the eye of an adult, may set up all the phenomena of the truly gonorrhœal form. We must not expect, therefore, to be able in every instance to say with certainty, the first time a patient comes before us, 'This is simple purulent ophthalmia;' or, 'This is of gonorrhœal origin;' we must wait until we have had time to watch the progress of the case.

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* It was termed by Morgan 'Aphthous Ophthalmia.'

If a patient presents himself in an early stage of purulent ophthalmia, we may, as I have said, be unable to distinguish the disease from the simple catarrhal form; but should the purulent ophthalmia have reached its height, we should find the following appearances.

The patient is generally pale and depressed; the lids are of a dull red, inclining to purple; they are swollen and œdematous, often to such an extent as to prevent the patient separating their margins in the smallest degree. When the surgeon draws them apart, thick yellow secretion oozes from the conjunctival surface, and if allowed to dry, forms a crust, which almost hides the eyelashes from view. The inability to open the eyes very naturally induces the patient to believe that he is blind, and this belief tends still further to depress him both in body and mind. To separate the lids, to cleanse the cornea from the secretion which overspreads it, and thus to give the patient a glimpse of surrounding objects, is often the best means of raising his general powers.

In a case of extreme inflammation, such as I am now describing, the conjunctiva covering the globe is reddened, infiltrated with serum, and raised to a considerable extent above the surface of the sclerotic. This is especially the case immediately around the cornea, the conjunctiva being thrown up into a roll which overlaps the corneal margin. This raised condition of the inflamed conjunctiva constitutes what is termed *chemosis*— a very characteristic mark in this and other forms of severe inflammation. In exploring the surface of the cornea, the surgeon should not content himself with merely cleansing it from secretion by means of a bit of wetted lint or sponge; but with a probe or little spatula he should carefully lift up the overlapping portion of the chemosis, in search of any hidden ulcer; for it is at the extreme edge of the cornea that the ulceration sets in, which may eventually go on to perforation.

The milder cases of purulent ophthalmia stop short of the ulcerative stage; and under appropriate treatment the puriform secretion ceases, the conjunctiva gradually loses its unnatural vascularity, and regains its healthy aspect.

The severer cases terminate either in *ulceration* or *slough* of the cornea. The ulceration usually begins, as I have said, at the corneal margin, and as it extends assumes the form of a more or less deep crescentic groove. Then the ulcer perforates the cornea at some point, and a portion of iris prolapses, producing the appearance of a small dark-coloured nodule at the bottom of the ulcer.

Of course any protrusion of the iris must cause deformity of the pupil, which becomes pear-shaped, oval, or reduced to a narrow slit, in proportion to the amount of iris which has escaped through the ulcer. Sometimes the ulceration spreads as a deep groove quite around the margin of the cornea, so as to isolate its central portion, which stands out in relief, cloudy or wholly opaque. Eventually this central portion becomes involved in the ulcerative process, and then the whole cornea becomes thinned, so as to yield to the pressure of the contents of the globe, and forms a bulging mass made up of the remains of the corneal tissue, between the fibres of which dark-coloured portions of exposed iris protrude. At a later period the surface becomes traversed by ramifying blood-vessels. This wholesale destruction of the cornea, however, rarely occurs except in cases of gonorrhœal inflammation. Sometimes purulent ophthalmia, instead of inducing ulceration, ends in *sloughing*. In that case the chemosed conjunctiva encroaches a good deal upon the surface of the cornea; the latter becomes hazy, then opaque and yellowish, and quite dull on the surface; at last it looks almost like a piece of wash-leather, then softens and comes away in shreds; the whole iris bulges forwards, and becomes coated with a fibrous exudation, which eventually transforms the part into a *staphyloma*.

Purulent ophthalmia can undoubtedly be transferred from one person to another by contact with the secretion. Patients, therefore should be cautioned on this point, as also their nurses or attendants. It seems probable that in hot countries, where this ophthalmia is very prevalent, the flies act as propagators of the disease. The dust also of those countries, by keeping the conjunctiva in a state of chronic irritation, no doubt predisposes to the attack. In England the disease, like the common catarrhal form, is, I think, most frequent during the extreme heat which sometimes visits us in July or August, if it be attended, as is often the case, with an east wind.

Treatment.—Although the more rational practice of the present day has effected a vast reform in the treatment of so-called inflammatory diseases, both internal and external, the force of old prejudice and habit has, to a great extent, prevented medical men from applying the same reasoning and common sense to the treatment of eye-diseases which they apply to those of other organs of the body. And, indeed, if a practitioner, unaccustomed to meet with ophthalmic cases, turns in his difficulty to many a work of high authority, published in his own day, he finds such a system of depletion recommended for purulent ophthalmia as is positively frightful.

Purulent ophthalmia, in its severe form, is usually met with in patients who are irritable, pale, and depressed. And this is almost certain to be the case if the disease be seen at an advanced stage; for the popular notion of the disease, and indeed, of nearly all diseases of the eye, is, that depletion of every kind is the only way to combat them. So true is it, that the vulgar errors of to-day are but the solemn medical dicta of our forefathers.

If the patient's bowels have been well relieved, the first requisite is usually a narcotic at bedtime. I almost always give tincture of hyoscyamus, ♏xxv. or ʒss. or even ʒj. in camphor-mixture, unless the patient has been habituated to the use of opium, when a moderate dose of that drug may be preferable. It is not easy to lay down positive rules for diet, but it should be such as is best calculated to keep the patient's vital powers to the level of ordinary health; as much of plain nutritious food being taken as the stomach can digest, and just such an amount of stimulants as will aid digestion, and maintain the due vigour of the circulation. Quinine is almost always useful in suitable doses. In short, ulceration and sloughing of the cornea should be combated or guarded against, just on the same principles as those destructive processes would be combated in any other tissue of the body. To a delicate, ill-fed, over-worked woman, attacked with acute purulent ophthalmia, it may be necessary, in addition to a little beer at her dinner, to order a glass of wine twice or thrice a day. To a person in a comfortable position in life, the ordinary amount of stimulants may be amply sufficient, while, with one habitually intemperate, a considerable diminution of the accustomed quantity may really effect the desired object, by avoiding that after-depression of the nervous system which invariably follows over-indulgence in drink.

The local treatment of purulent ophthalmia consists in the frequent employment of astringents, such as alum, nitrate of silver, or tannin, dissolved in distilled water. The alum may be used in the proportion of eight or ten grains to the ounce, and applied by means of a fine soft rag, every hour during the day, and as often during the night as is compatible with the patient's rest. Where the surface of the globe can be well exposed by drawing down the lower lid, it may suffice to dab the surface of the palpebral conjunctiva and to squeeze the lotion over the surface of the eye from the rag or a fine sponge. If there be so much swelling of the lids as to make it impossible to expose the surface of the globe, the lotion must be injected beneath the lids with a syringe, first throwing in a little warm water to clear away the discharge. As the case improves, the lotion may be used less frequently, every two or three hours. If nitrate of silver be employed, it should be in the proportion of three or four grains to the ounce, and be dropped upon the surface of the globe three or four times a day, after syringing away the discharge with a little warm water. Tannin dissolved in distilled water may be used as a substitute for the alum. In some severe cases which assume the violence of the gonorrhœal form, ulceration rapidly extends along the edge of the cornea—usually the lower edge—in the form of a deep crescentic groove. Unless speedily arrested, it penetrates the thickness of the cornea, and if the opening into the anterior chamber be large, so much of the iris may prolapse as greatly to diminish, or wholly to annihilate the pupillary aperture. In such cases it is sometimes possible to check the spread of the ulcer by rapidly passing over its entire surface a fine point of nitrate of silver. A fine probe, coated with the fused salt, is usually the best means of application.

I need hardly allude to the great importance of pure air in the disease now under our notice. In fine weather it is not necessary, even during the acute stage, wholly to confine the patient to the house; and when the ulceration is arrested, and the purulent discharge has ceased, careful and judicious change of air will tend more than anything else to remove the chronic ophthalmia, which is otherwise apt to linger on for a long period.

GONORRHŒAL OPHTHALMIA.

This disease is essentially the same in character as the preceding; but is far more severe and destructive. It is caused by gonorrhœal matter coming in contact with the conjunctiva; and among the more ignorant classes it is sometimes the result of a very prevalent vulgar error—that a sovereign remedy for sore eyes is to bathe them in the patient's own urine.

I know of no symptom by which we can positively distinguish ordinary purulent ophthalmia from the gonorrhœal form, provided the two diseases are seen at an early stage. Many authors speak of gonorrhœal ophthalmia as almost invariably confining itself to one eye; but this is certainly not the case; and I could relate many instances in which both eyes were attacked within a few days of each other. Indeed, it seems strange that this is not the rule rather than the exception.

Gonorrhœal, like ordinary purulent ophthalmia, begins with redness of the conjunctiva, and a sensation of sand beneath the lids. After a few hours muco-purulent discharge sets in, and the ocular portion of the conjunctiva becomes infiltrated with serum. This thickening rapidly increases and forms a *chemosis*, which is always a very marked symptom in gonorrhœal cases. At the same time the lids become red, and so much swollen that the patient can separate them to only a very slight extent. The cornea becomes hazy; and at this stage an ulcer is almost certain to be found at its margin. Sometimes ulceration begins while the rest of the cornea is still clear; and in that case some care is necessary to detect the loss of substance. A thorough examination of an eye at this stage of the disease cannot be made without the aid of the wire speculum, which prevents the swollen conjunctiva of the lids from bulging over and hiding the cornea. If the margin of the cornea be overlapped by chemosis, a probe or little spatula should be used to hold it aside, while the surface of the extreme edge of the cornea is wiped perfectly clean with a bit of wetted lint or rag.

Patients affected with gonorrhœal ophthalmia are almost always in a state of depression, with weak pulse and deranged digestion. This condition is partly due to the local disease itself, and partly to the distress of mind caused by the fear of impending blindness. It seems extraordinary that surgeons of eminence can have been so far misled by theoretical notions about 'inflammation' as to have overlooked the general condition of these patients, and to have treated them by frightful bleedings, mercury carried to salivation, and other depressing means. Those of my readers who may imagine that the so-called 'antiphlogistic' plan of treating gonorrhœal or severe purulent ophthalmia belongs to the remote past, need only turn to the works of those who, thirty or forty years ago, were the great authorities of ophthalmic practice, to find that profuse bleeding, mercurialism, and a diet just stopping short of actual starvation, are enjoined as the best means of arresting ulceration and sloughing in the eye; while the very same authorities would have condemned, as *mala praxis*, such treatment of similar morbid processes in the arm or in the leg. One author tells us, that 'the *only case* of gonorrhœal ophthalmia he had seen in which the eye was saved was that of a young woman, in whom venesection was repeated as often as blood could be got from the arm. She lost 170 ounces of blood in a few days, and looked as if every drop of blood had been drained from her body, the skin having nearly the hue of a wax-candle.' One would have thought that the adage, *exceptio probat regulam*, would have occurred to this surgeon's mind, and that he would have regarded a system as self-condemned under which *only one* eye had escaped destruction. But he never seems to have had the slightest suspicion that the system could be wrong.

A second authority quotes, among other cases, the case of a young man who, on the first day, had been bled to fainting, then vomiting was kept up by tartar-emetic as long as it could be borne. In the evening, the pain in the eye had become worse; he was bled again. On the following morning the swelling of the lids was greatly increased, so that the eye could not be seen, and there was copious yellow discharge; the night had been passed in severe pain, which entirely prevented sleep. Bleeding was repeated twice more: blood was taken, by cupping, from the back of the neck and the temple, and leeches were applied around the eye in large numbers; 'but although the free use of purgatives and antimonials, with low diet, was combined with these measures, no sensible effect was produced in diminishing the violence of the inflammation, or arresting its progress.' Still no misgiving as to the soundness of the system! A third surgeon tells us, that 'the lancet must be hardly ever out of our reach; for if ever there was a disease in which blood may be taken away without limitation, it is this.' A still later authority, in a bulky text-book, written little more than thirty years ago, says: 'You will deem it necessary to bleed at the outset of the attack most freely; it would be almost criminal to stop the flow of blood until your patient exhibited symptoms of faintness; and as soon as he rallies, and the pain returns, the operation should be repeated until syncope is again produced. At the same time you would prescribe a liberal dose of calomel and jalap, so as to act freely on the bowels, and afterwards the tartarised antimony in sufficient quantity to maintain a state of decided nausea. You would also freely scarify the conjunctiva, . . . taking care to divide the texture of the conjunctiva at each sweep of the knife, so as to penetrate as far as the fluid effused into the subconjunctival cellular membrane. Bleeding from the conjunctiva is to be encouraged. A weak alum-lotion is to be used, and the diet is to be limited to light fluid aliment.' An injunction hardly necessary, since one cannot see how a man who has been kept in a state of perpetual nausea is to retain any food at all. But the patient is not to escape with only this amount of depletion. 'You would proceed to apply a quantity of leeches just below the tarsal margin of the lower eyelid, and direct the application of a blister between the scapulæ. Lastly, it may be necessary to use tonic and stimulating lotions, . . . and to employ a restorative regimen to reinvigorate the reduced powers'! Powers, be it observed, which have been reduced by the surgeon himself. We are to pull the house down, and then try to build it up again.

I may be told, that it is useless to bring forward such cases as these; that the current of medical opinion is changed, and that it now sets strongly against bleeding and depletion, and rather towards a tonic and stimulating plan of treating diseases. I am glad to acknowledge that such is the fact; but, by some strange fatality, the arguments which are allowed to apply to other diseases are still, to a certain extent, ignored so soon as diseases of the eye come to be treated. Some of the works from which I have quoted are still referred to by those who have only occasional opportunities of seeing cases of gonorrhœal ophthalmia, and I cannot therefore think it superfluous to warn my readers against this system of Sangrado-like depletion.

Even Tyrrell, who in his treatment of other diseases laid so much stress upon supporting the powers of the patient, seems in the instance of gonorrhœal ophthalmia to have followed the track of his predecessors as to bleeding. He introduced a new method of scarifying the conjunctiva, which he believed to be destined to effect a total change in the treatment of the disease. It was founded upon the theory that the cornea perished by sloughing; that this sloughing was caused by fibrinous effusion beneath the conjunctiva immediately surrounding the cornea, whereby the vessels supplying the cornea were compressed, and their circulation impeded. He assumed that the cornea derived the whole of its nutrition through blood-vessels passing into it from the conjunctiva, and quite ignored the fact of any vessels passing to it from the sclerotic, and he would have utterly repudiated the notion of there being such a substance in the human body as a non-vascular tissue. The elevated roll of conjunctiva, constituting what is called the chemosis, was to him the great source of danger, and this was to be freely divided by means of radiating incisions, so as to allow the effused fibrin to escape, and the vessels supplying the cornea to be relieved from pressure. The anatomical mistake upon which Tyrrell's practice was founded was well exposed at the time by Wharton Jones.

The fact is, that the cornea, in severe cases of gonorrhœal ophthalmia, does not simply perish by sloughing, in the same way as a tumour strangulated by a ligature perishes. Ulceration first attacks the extreme edge of the cornea, in the manner I have described at page 35, and extends in a crescentic form until a considerable portion of the cornea has been cut off from its nutritive supply, and then of course it loses its vitality. In some cases, I have seen the ulceration extend all round the corneal margin; and then the central isolated portion, having previously become opaque, has rapidly assumed a softened pulpy appearance, and come away in shreds. The chemosis, which has been so much dreaded as the active agent in the destruction of the cornea, is merely formed by the infiltration of serum from the overloaded blood-vessels into the subconjunctival cellular tissue. Of course chemosis is an important symptom whenever it occurs, because it proves a congested condition of the blood-vessels of the conjunctiva, with which there is generally associated a congestion of other more important tissues; but to reduce the patient's vital powers by bleeding, mercury, and low diet, and then to expect to save the cornea by cutting the conjunctiva, appears to be utterly irrational, and opposed to the first principles of physiology and common sense.

In speaking of purulent ophthalmia (page 36) I have anticipated the treatment of the gonorrhœal form. It is quite impossible to lay down positive rules as applicable to all cases. Each case becomes a study in itself, and according to the patient's constitution, habits, station of life, and previous treatment, must the surgeon modify his plan. To maintain the digestive functions, to administer suitable quantities of nourishment, to sustain the circulation at a proper point of vigour, neither unnaturally exciting it to hurried action, nor allowing it to flag, and so lead to local congestion of blood, and consequent deterioration of tissues—to secure as far as possible pure air at an equable temperature, to soothe the nervous system, and promote sleep by such mild narcotics as shall not confine the bowels or induce subsequent depression—such is the outline of the general treatment to be pursued.

The local applications I have already indicated at page 37, only I would lay still greater stress, in cases of gonorrhœal ophthalmia, upon the utility of nitrate of silver, applied in substance to the surface and edges of the crescentic ulcer. Unless this application be made with great care and neatness of hand, it may do more harm than good. A stick of nitrate of silver can hardly be pointed so sharply as to answer the purpose, and a fine probe, upon the end of which a small portion of the salt has been fixed by fusion, is to be preferred. The lids being held apart with a wire speculum, and the edge of the cornea having been wiped clean, the fine point of nitrate of silver is to be lightly passed over the whole surface of the ulcer. This application may require to be repeated after a couple of days, but should not be persevered in after the ulceration has ceased to spread.

In spite of all our efforts and care, it must frequently happen that cases of gonorrhœal ophthalmia terminate in loss of sight. For the disease often occurs in unhealthy subjects, weakened by intemperance and debauchery, and who, before they apply to a regular practitioner, have probably been in the hands of quacks, whose only remedy is mercury. Still, when we consider of what immense importance it may be to retain even a small portion of the cornea in a transparent condition—thereby enabling the surgeon at some future time to make an artificial pupil, and so rescue the patient from blindness—we ought never to give up a case of gonorrhœal ophthalmia so long as any portion of one cornea retains its vitality.

GRANULAR CONJUNCTIVA.

(*Granular Lids; Trachoma.*)

One of the most serious sequelæ of purulent ophthalmia, whether of the simple or the gonorrhœal form, is that condition of the conjunctiva termed 'granular,' involving a hazy and vascular state of the cornea. During the progress of purulent ophthalmia, the palpebral conjunctiva, when cleansed from secretion, appears villous; and, after the purulent discharge has ceased, this condition of the membrane goes on increasing, until its surface resembles that of a granulating ulcer. The so-called 'granulations,' however, are in reality the follicles and papillæ of the conjunctiva, enlarged by inflammatory deposits. The firmness and solidity of these 'granulations' vary much in different subjects. When hard, and of considerable size, they cause irritability and blinking of the lids, and lacrymation, and after a time the cornea, especially its upper half, becomes hazy, and is traversed by numerous large vessels, forming in some cases a complete network, and giving an almost fleshy aspect to the part (*pannus*).

Treatment.—The granulations were long since recognised as causing by their friction the chronic inflammation and vascularity of the cornea; and accordingly, a great variety of plans have at various times been adopted for removing the granulations, and restoring smoothness to the palpebral conjunctiva. Complete excision with the knife or scissors, the rapid action of escharotics, and the more gradual wasting by means of astringents, have all in turn been employed against granular lids.

Effectually to cut away the granulations requires such extensive removal of the palpebral conjunctiva as is likely to induce permanent curving of the tarsus and consequent entropion; and the same result may follow the free employment of nitrate of silver. The ordinary astringent lotions of alum, tannin, &c. are powerless in the more severe cases. I have seen much benefit from the acetate of lead, applied by dusting it, in fine powder, over the everted lid. This causes a good deal of pain at the time, but afterwards gives decided relief, apparently by mechanically filling up the interstices of the elevations, and so producing a smooth surface for the eyeball to move upon. The salt, as it slowly dissolves, seems also to exert an astringent effect upon the vessels of the enlarged follicles and papillæ, and so to diminish their bulk. But the most effectual means I have ever tried for removing granulations is the undiluted liquor potassæ, applied by dabbing it upon the everted lids, on which it seems to act by chemically saponifying and dissolving away the hypertrophied tissue. The application may be repeated at intervals of a few days; and six or seven weeks of this treatment will sometimes suffice to remove the granulations, and, at the same time, to restore a considerable degree of clearness to the cornea.

But, every now and then, cases are met with in which the cornea is so opaque, and so traversed by large blood-vessels, as to prevent useful vision, even when the granular state of the lids has been almost subdued. Such instances of opaque and vascular cornea follow severe purulent ophthalmia, especially the form so common in the East, and known to us as Egyptian ophthalmia. Cases of almost equal opacity are met with at our London hospitals, among the more destitute Irish patients. It appears that a very severe form of purulent ophthalmia is sometimes epidemic in certain districts of Ireland, rivalling in virulence the disease of tropical countries.*

Patients who have been a long time suffering from granular lids in a severe form are almost invariably out of health; often reduced by the violent courses of medicine they have undergone, and with the eyes in an irritable condition from long-continued use of caustic applications. To place such patients, if possible, in a pure and bracing air, and to improve their general health by suitable tonics, will be the first indications for treatment. Caustics and stimulants should be laid aside, and counter-irritation employed by means of small blisters to the temple, and tincture of iodine to the skin of the lids. In this way considerable improvement may be induced both in the condition of the lids and of the cornea; but there will still remain certain inveterate cases, incurable by any ordinary treatment, either local or general. They usually present a granular condition of the palpebral conjunctiva; this, however, may have been got rid of, or greatly subdued, by treatment; the characteristic sign, which makes the disease so formidable, is the haziness and vascularity of the cornea.

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* Power, in a pamphlet on the Egyptian Ophthalmia, published in 1803, describes a species of the same disease as being 'frequently prevalent among the Irish peasantry, and considered by them to be infectious.' See also a paper by Wilde in the *London Journal of Medical Science*, vol. iii. 1851.

We will suppose a case in which the granular condition of the lids has been partially or wholly cured, and the general health restored; but where, after exhausting every resource of his art, the surgeon still finds the patient's corneæ permanently opaque, and traversed in all directions by vessels, vision being limited to the mere recognition of large objects. There may be every reason to believe that the tissues of the eye posterior to the cornea still remain healthy, and yet the condition of the latter destroys all hope of good vision being regained.

For such desperate cases a seemingly desperate remedy—*inoculation*—has been proposed, consisting in the production of a fresh attack of purulent ophthalmia, by applying to the conjunctiva some morbid secretion from the eye of a patient suffering under the acute form of that disease.

This treatment was extensively tried in Germany several years ago, but seems to have fallen into disuse, and only of late to have been revived. Its advocates asserted that purulent ophthalmia, thus produced in an eye which had previously undergone the disease, would cause a wasting of the vessels overspreading the cornea, and ultimately restore its transparency. There seemed, however, a great risk of the second attack proving as severe as the first, and ending in destructive ulceration of the cornea; and the fact of the inoculation serving to keep up and perpetuate a dangerous and contagious disease, also operated with many surgeons as a reason for wholly discountenancing the practice. These considerations for some time induced me to abstain from the experiment. I had seen cases in which inoculation was followed by perforating ulcer of the cornea; but, at the same time, I had seen others in which considerable clearing of previously opaque corneæ took place without any ulceration whatever.

The first case in which I tried inoculation was one which seemed peculiarly suitable for it. The patient, a discharged soldier, was in good general health, but quite helpless in consequence of the state of his corneæ. They were so hazy that the position of his pupils could not be traced, and were traversed in every direction by vessels. He had perception of reflected light and colours, but could not distinguish a hand from a sheet of paper, except by the difference of tint. Although the granular state of the lids had been nearly subdued, the condition of the corneæ during three years had been proof against every mode of treatment.

Some pus from the eye of a patient with purulent ophthalmia was applied to each conjunctiva. Intense inflammation set in, and on the third day there was already chemosis with thick purulent discharge. A week later, both corneæ were so covered with a yellowish flocculent layer as to appear to be in a state of complete slough. This substance, however, in the course of a few days, had disappeared, and the corneæ were found to be entire, presenting a somewhat translucent aspect, although the chemosis and discharge still continued. As no local application except cold water was permitted, and no astringent used to control the discharge, it continued in a slight degree for some months. Meantime the corneæ, as they became clearer, presented but few traces of the vessels by which they had been so plentifully traversed. Six months after inoculation, the patient could recognise features at a distance of twelve feet, and with perfect security could go about the streets of London alone. There still remained such a degree of haziness about the centre of each cornea as prevented him from reading ordinary type, No. 16 of Jæger's specimens being the smallest characters he could readily make out.

I have since used inoculation repeatedly, and so many cases have been reported by others, that I should not have quoted this single case, except on account of its bearing upon a point which I think has not been sufficiently attended to, namely, the varying results of inoculation in respect of its inducing corneal ulceration.

The vitality of the cornea is put to a very severe test when the suppurative inflammation sets in with such intensity as is exemplified in the case just mentioned. If the cornea be abundantly supplied with blood by vessels traversing it in every direction, it will probably resist both ulceration and sloughing; whereas, a simply opaque and non-vascular cornea may be destroyed, or at least perforated, on account of mere deficiency of blood-supply. The abundant vessels which had prevented the cornea duly performing its function of transmitting light, serve to keep it alive while the inflammatory stage is going on, and so enable it eventually to recover its transparency and usefulness. The very circumstance, therefore, of the cornea being in a hyperæmic condition is favourable, as regards its ability to support the violent means employed for the restoration of its transparency.

Those who for the first time resort to inoculation in a case of corneal opacity, resulting from bygone purulent ophthalmia, will probably be dismayed when they witness the immediate result of their experiment; and will give up the cornea for lost when they see it overlapped and nearly hidden by chemosis, and catch a glimpse of its dead-yellow, slough-like surface. This, however, becomes detached, and leaves beneath it a translucent cornea, which, provided it has been well nourished with blood, may gradually advance in clearness, until it almost loses the marks of its former degeneration.

Throughout the treatment no attempt is to be made to arrest the discharge, cold water only being used as an external application in cleansing the eye. The patient should be allowed a nutritious diet, and on no account undergo depletion.

Even under the most favourable conditions, as regards the patient's general health, and the blood-supply of the cornea, inoculation must be a hazardous experiment; and it should, therefore, be reserved for those cases where the vascular opacity of the cornea has bidden defiance to all other forms of treatment, and has deprived the patient of all useful sight.

Purulent Ophthalmia of Infants.

(*Ophthalmia neonatorum.*)

This disease is closely allied in its symptoms to that just treated of, although not arising from the same specific form of infection.

Both diseases derive all their importance from the liability of the *cornea* to become ulcerated. The cause of *ophthalmia neonatorum* has given rise to much controversy; some regarding it as only an aggravated form of catarrhal ophthalmia, while others consider it as in every case due to contamination with the vaginal discharge of the mother. The latter is perhaps the more probable explanation, the difference in the intensity of the disease depending upon the more or less virulent nature of the discharge.

The ophthalmia begins a few days after birth. It may not for some time assume any intensity, and hence it is often overlooked in its early stage; and we are told that it did not begin till the child was two or three weeks old. When the child is jaundiced, the discharge assumes a deep yellow colour.

The surgeon's first object should be to ascertain to what extent the corneæ are involved. Having secured the infant's head between his knees, he should carefully introduce between the lids a wire speculum, of a size and strength of spring proportioned to the small palpebral opening of so young a child.

With a bit of moistened lint the discharge should be gently wiped away, so that the surface of the cornea may be thoroughly explored. If an ulcer exists, it will most commonly be found at the centre. It may occupy the whole area of the pupil, or involve all the cornea except its extreme edge, or the iris may be seen protruding through a complete perforation of the cornea in the form of a brownish nodule. If the whole cornea be destroyed, the iris will be seen bulging forward, covered by a thin glaze of semi-transparent inflammatory deposit. Sometimes it seems as if the posterior elastic lamina had resisted the ulcerative process, and still formed a thin coating to the bulging mass of iris. These are the cases which eventually exhibit *staphyloma*; the deposit upon the iris becoming by degrees thicker and denser, and assuming very much the appearance of opaque, or partially opaque, corneal tissue, over the surface of which, at a later period, arborescent vessels ramify. When the perforating ulcer of the cornea is very large, it not uncommonly happens that the lens escapes through the aperture

When the purulent ophthalmia is at its height, the lids are red and swollen; but when the cornea has given way, the bright rosy tint of the lids usually gives place to a dull livid colour, the swelling subsides, and the skin becomes flabby. The palpebral conjunctiva, when cleansed from the discharge, appears bright-red and villous.

Treatment.—The nutrition of an infant attacked with purulent ophthalmia is so important—as the means whereby the ulcerative process may be averted, or, if that process have already commenced, reparative material may be supplied for filling up the breach—that, before alluding to local treatment, I would insist upon the importance of the child being suckled, and not brought up by hand. A weakly infant, attacked with severe ulceration of the cornea, and fed with artificial food, has hardly a chance of recovery. Of course the condition of the bowels must be attended to; but care must be taken not to lower the child by unnecessary doses of 'grey powder'—that panacea for infantile complaints, according to popular belief. Weakly children are often benefited by a few drops — four or five—of Battley's liquor cinchonæ; given in a tea-spoonful of milk twice a day.

In the local treatment, all depressing and so-called 'antiphlogistic' measures are to be carefully avoided. Blistering is perfectly ineffectual towards controlling the discharge, and only weakens and irritates the general system. Abstraction of blood by leeches is even worse, as depriving the child of that reparative material which is so urgently required for averting or healing ulceration. I know of no application better than a solution of alum—five, eight, or ten grains to the ounce of distilled water—which should be injected between the lids every half-hour. It is well to inject a little warm water before using the alum-lotion, so as to wash away the discharge, and thus allow the alum to come completely into contact with the inflamed conjunctiva.

As the discharge abates, the lotion may be injected less frequently—every hour, or every two hours. Care must be taken not to chill the infant by wetting its clothes during the injecting.

The condition of the cornea must be carefully inspected from day to day. If there be a large ulcer, and the reparative process have set in, the surgeon must not be uneasy on observing that the surrounding portion of the cornea looks cloudy and reddish. This pink tinge is owing to the presence of blood-vessels, advancing towards the ulcer, and conveying to it reparative material. When the ulcer has become completely filled up, these blood-vessels will gradually disappear, and the peripheral portion of the cornea, in which they ramified, will resume its transparency.

Sometimes it is useful to change the local application, and to use a solution of nitrate of silver—two grains to the ounce—dropping a small quantity on the conjunctiva twice or thrice a day. This change of stimulus often acts beneficially, when the puriform discharge has almost ceased, and the ulcer still shows little disposition to heal. As soon as the ulcer begins to fill up rapidly, the alum or nitrate of silver should be used less frequently.

In severe cases of purulent ophthalmia, eversion of the swollen conjunctiva of the lids frequently occurs. This always gives rise to alarm among those who have charge of the child, and is often a cause of anxiety to the surgeon. It is a matter of no real importance; the eversion cannot be controlled by any artificial means, and is sure to cease as soon as the puriform discharge has abated.

'SCROFULOUS OR STRUMOUS OPHTHALMIA.'

(*Phlyctænular Ophthalmia*)

If by 'ophthalmia' we are to understand an inflammatory affection of the *conjunctiva*, this disease ought not to be termed ophthalmia at all. It is essentially a corneal disease, the conjunctiva being only secondarily affected, and I have therefore transferred it to the chapter in which Diseases of the Cornea are described.

CHRONIC OPHTHALMIA.

The acute stage of common catarrhal ophthalmia, if neglected, is apt to subside into a chronic form, characterised by a congested state of the palpebral conjunctiva with an increase in its mucous secretion, an unnatural fulness of the caruncle and semilunar fold, and some degree of redness along the tarsal edges. The patient complains of a sensation like that produced by a small foreign body beneath the lids; luminous bodies appear surrounded by a halo of prismatic colours; the eyes water when exposed to bright light or cold winds; and the lids are gummed together in the morning.

The surgeon, on first seeing such a case, should most carefully explore the edges of the tarsi, to see if any fine eyelashes are growing irregularly, so as to touch and irritate the globe. A single delicate hair, so fine as almost to elude observation, will sometimes suffice to keep up, or even of itself to produce, most of the symptoms I have just described.

Chronic ophthalmia, characterised by the above symptoms, is not always a sequela of acute inflammation. Indeed, it more commonly occurs as a primary disease, in persons whose occupations oblige them to sit for many hours in close and overheated rooms, while engaged on minute objects, especially under artificial light.

Treatment.—When we consider the various classes of persons liable to chronic ophthalmia, it is obviously impossible to lay down rules of treatment which shall be universally applicable. To rectify whatever may be found amiss in the general health, is the first indication. The injurious effects of artificial light chiefly depend upon the abundance of red rays inseparable from every form of it. These may be modified by adapting to the flame of the lamp, or gas-burner, a chimney or shade of transparent glass, slightly tinted with blue. The colour should be so faint as only just to whiten the flame, without imparting to it any decidedly blue tinge.

An immense variety of substances has been used in lotions and drops for the cure of this troublesome affection. Acetate of lead, alum, sulphate of zinc, nitrate of silver, sulphate of copper, tannin, &c., have all found their special admirers. Vinum opii was long a favourite form of drop; while the more homely washes of diluted brandy or vinegar have found favour as domestic remedies. Whatever form may be preferred, care should be taken not to make the solution too strong, and not to use it for too long a time without intermission. The object should be to stimulate the conjunctiva for a short period, and then to give it time to resume its natural functions. Many persons, by the habitual use of strong lotions, keep up the very condition they are seeking to cure. Acetate of lead, or alum, in the proportion of from two to four grains in the ounce of water, are perhaps as useful as any of the more common substances. Bathing the eyes in cold water, night and morning, is in many cases preferable to the use of any medicated lotions. An occasional small blister to the temple is useful when the eyes become suddenly irritable and intolerant of light.

Injuries of the Conjunctiva.

The more serious of these are due to contact with escharotics, heated fluids, or melted metal. Slight lacerations or cuts of the conjunctiva, not involving the sclerotic, require only very simple treatment—water-dressing and closure of the lids. Strong mineral acids, caustic alkalies, and other chemical substances, often produce the most destructive effects upon the conjunctiva and cornea, causing bands of adhesion to form between the lids and the globe, and inflicting upon the cornea such an amount of opacity as wholly to destroy sight. The damage in these cases is so instantaneous that the surgeon has hardly ever the opportunity of neutralising the destructive fluid. If at hand at the moment of the accident he would of course at once inject between the lids such a fluid as would chemically decompose the acid or caustic alkali, and form a neutral salt. Afterwards a little castor-oil or olive-oil may be dropped upon the surface of the globe, and water-dressing applied over the closed lids.

Where melted metal has spurted into the eye, the surgeon should always evert the upper lid, and explore all the folds of the conjunctiva; for large portions of metal will sometimes lodge beneath the lids in the most singular manner, and remain there quite unsuspected for a long time.

When lime, mortar, sand, or other solid matters, have been thrown against the eye, the upper lid must be everted, and every particle of grit removed in the most careful manner with a small scoop. In such cases it will not do to trust to injections of water only, although they may be useful after the scoop has done its work.

If the surface of the conjunctiva presents an opaque thickened appearance, as if it had been boiled, and the cornea is also of an opaque and pearly hue, the damage to sight is irreparable, and only slight improvement is to be hoped for. In such cases the surgeon must take care not to weaken the patient by bleeding or low diet, for it is by keeping up the patient's reparative power that the life of the corneal fibres is to be sustained, and sloughing averted. Where a portion of the cornea is densely white and opaque, and the rest only slightly cloudy, the latter part may recover much of its natural transparency.

In those cases where the opposed surfaces of the palpebral and ocular conjunctiva have sloughed, it is impossible to prevent the formation of bands of adhesion; but these may be somewhat limited by the frequent use of a probe, to break down the newly-formed granulations.

Affections of the Subconjunctival Tissue.

ŒDEMA.

Pressure upon the trunk of the ophthalmic vein or its branches, by obstructing the return of blood from the conjunctiva and subjacent areolar tissue, is liable to produce œdema. In slight cases the œdema is confined to the lower part of the globe, where the distended conjunctiva sometimes overhangs the edge of the lower tarsus: it is only in extreme cases that the œdema extends to the upper part of the globe. In old persons, whose tissues are very lax, I have seen the margin of the cornea overlapped by the œdematous conjunctiva.

Œdema and chemosis only differ in degree; the former being a mere exudation of serum in consequence of pressure on the veins leading from the part, while the latter term is restricted to those cases where the conjunctiva and subjacent areolar tissue are actively inflamed. Abscess in the lids or in the lacrymal sac, tumours, and exostoses in the orbit, periosteal thickening in the neighbourhood of the ophthalmic vein—in short, any direct pressure on this vessel, may give rise to œdema, which cannot therefore be regarded as of itself constituting a disease, or as demanding attention, except as a symptom of something more important which has given rise to it.

ECCHYMOSIS.

Some of the small vessels beneath the conjunctiva may give way in consequence of a violent effort, such as coughing or vomiting, or sometimes without any assignable cause; in children with whooping cough such extravasation often takes place to a great extent. The blood may appear as a small patch on the white of the eye, or it may quite hide the sclerotic, and extend up to the edge of the cornea. The appearance is so peculiar that it can never be mistaken for inflammatory injection. In the latter the individual vessels can always be distinguished, while the extravasation presents the uniform aspect of a thinly spread-out clot.

Subconjunctival ecchymosis not uncommonly causes great alarm to the patient; but, except for its unsightliness, it is quite unimportant. The scraped root of the black bryony (*Tamus communis*) made into a poultice with bread crumbs or linseed meal, applied over the closed lids, and renewed every six hours, will hasten the absorption of blood. If this cannot be worn, frequent sluicing with cold water is the best thing to be done. Nothing, however, will cause the blood to be absorbed until after the lapse of several days.

PINGUECULA.

After the middle period of life, especially in persons who have been much exposed to the weather, or have lived in hot climates, it is very common to see small yellowish elevations on the sclerotic, close to the edge of the cornea, and on the equator of the eyeball. They are sometimes surrounded and traversed by a few fine vessels. When these little elevations attain their full size, they will be observed to have a somewhat triangular form, the base corresponding to the cornea. They have received the name of *pinguecula* from their being supposed to consist of fat; much of their bulk, however, is made up of fibrous tissue. Pingueculæ are growths so entirely harmless that they would not call for a remark, were it not that they very often give rise to the most serious alarm in the patient, who believes that they will gradually grow over the pupil and obstruct the sight. An explanation of their real nature comprises all that is required on the part of the surgeon.

PTERYGIUM.

This consists in a reddish, fleshy-looking growth extending from the semilunar fold to the cornea, the margin of which it frequently oversteps. It has a triangular shape, its base corresponding to the inner canthus. Slighter forms of this growth are met with, in which, instead of looking like a portion of muscle, the fibres are so thin and delicate as rather to resemble an aponeurosis with a few muscular fibres intermixed. No muscle, however, is found in these growths, which consist of fibrous tissue abundantly intermixed with blood-vessels.

Pterygium, like pinguecula, is found in persons past the middle period of life, and especially among those who have lived in tropical countries. The dust, which is there so abundant, may probably be an exciting cause. A very well-marked case came under my care in a mason and plasterer, who, although always residing in the neighbourhood of London, had of course been much exposed to dust of various kinds. The largest pterygium I ever saw, however, was in a countryman from Essex, in whom the apex of the growth, instead of stopping short of the area of the pupil, as is commonly the case, spread so far across the cornea as almost to hide the whole of the pupil. In this case I removed the growth; and whenever the apex extends so far as to occupy a large portion of the cornea, the deformity it produces may demand an operation. The lids being held asunder with a spring speculum, the lax portion covering the sclerotic is to be nipped up in a forceps, and cut across with a fine scalpel midway between the edge of the cornea and the semilunar fold. The portion extending towards the cornea may then be dissected off the sclerotic, great care being taken when that part is removed which adheres to the cornea. It is well not to remove the inner third of the pterygium, as otherwise the semilunar fold and caruncle are apt to retract, which afterwards gives an unpleasant prominence to the eyeball.

No other local treatment than removal with the knife or scissors is of any avail in getting rid of a pterygium. Stimulating lotions and drops only excite it to grow; and the varieties of pterygium described by authors, under the names of *sarcomatous*, *fungous*, *cancerous*, and *malignant*, were probably nothing more than common forms of the growth, irritated and teased by escharotics.

FATTY TUMOURS.

Fatty deposits to any large extent beneath the conjunctiva are uncommon. The few cases I have seen occurred in children, and the tumours all occupied the same position, namely, the line of reflection of the conjunctiva from the lower lid on to the globe. They extended from near the lower edge of the cornea to the outer canthus, were of an elongated form, almost resembling a haricot bean, and were partly concealed by the lower lid. On dividing the conjunctiva and the proper fibrous envelope, the fatty mass was easily turned out.

CYSTICERCUS TELÆ CELLULOSÆ.

This parasite is occasionally found in the subconjunctival cellular tissue, but it appears to be of very rare occurrence. I have seen but two instances, both in females, one patient being six, the other eighteen years old. The appearance was that of a rounded body, about as large as a pea, midway between the inner canthus and the cornea. There was a good deal of vascularity in the conjunctiva covering and surrounding it. In the first case a little watery bladder, rather larger than a pin's head, had been observed about eighteen months before the patient was brought to me. In the second case, no account could be given as to the first appearance of the growth. On the conjunctiva being divided, the cysticercus slipped out, and was at once recognised under the microscope. Sichel, in his *Iconographie*, gives a very good figure of a cysticercus in the position I have described (pl. lxxii. fig. 2), and also of one developed beneath the plica semilunaris (fig. 1). In other figures of the same plate, the animal is shown both in its natural size and magnified.*

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* Græfe mentions five cases of subconjunctival cysticercus as having occurred in his *clinique*, during a period of thirteen years. *Archiv für Ophthalmologie*, xii. 2, 174.

At the time I saw these two cases the connection between the development of tænia in the intestines, and of cysticercus in other parts of the body, had not been pointed out; nor was it suspected that two creatures so dissimilar were really the same animal under different forms of development.*

STAINS FROM NITRATE OF SILVER.

Before quitting the subject of affections of the conjunctiva and subjacent tissue, I may say a few words respecting the serious disfigurement which results from the prolonged use of nitrate of silver in solution. No surgeon who understands the real action of this substance—its invaluable efficacy in catarrhal ophthalmia, and its inutility or injurious effects in affections of the cornea—would be likely to employ it in such a manner as to produce permanent staining of the tissues of the eye; for in no case is its prolonged use of any service; the good it does, it does in a few days. Patients, however, have such unbounded faith in the efficacy of eye-drops and eye-waters, that they will frequently continue the use of them for months and even years.

One of the worst cases of staining with nitrate of silver I ever saw came under my notice only a short time ago. A woman, with incurable opacity at the centre of the cornea—the cicatrix of an ulcer, in fact—had been ordered to use drops of nitrate of silver. This she did for some months, under a surgeon's advice. She then went to another part of the country, but still continued the use of the drops, putting in, as she assured me, 'two drops every day for *ten years*.' The whole of her sclerotic was of a dirty sepia tint, most marked towards the lower part of the globe. The cornea itself slightly partook of the same tint, and the conjunctiva of the lower lid, thickened and vascular, looked as if a brush dipped in liquid sepia had been passed over it, the dull red colour of the conjunctiva being only seen where the membrane had formed a fold.

In another case, where this discoloration existed in a less marked degree than in the case just mentioned, I tried the effect of a solution of cyanide of potassium. The patient was an intelligent man, and could thoroughly understand the principle of the treatment, which was to keep the whole surface of stained tissue for a lengthened period in contact with the fluid. This was effected by the help of an 'eye-glass,' and I told the patient to draw down the lower lid, and to fix it against the cheek-bone with the rim of the glass, before throwing his head back. After several months but little benefit had resulted, and I then tried a solution of hyposulphite of soda, beginning with a strength of ten grains to the ounce of water—as the effect of the substance was unknown to me—and gradually increasing it up to a drachm to the ounce. The change effected was very slow, but when I last saw the patient the stain was barely traceable on close inspection.

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* See Küchenmeister, *On Animal and Vegetable Parasites of the Human Body:* and Von Siebold, *On Tape and Cystic Worms*; published by the Sydenham Society, 1857. See also the essay on PARASITES in the Appendix.

CHAPTER IV.

DISEASES OF THE CORNEA.

THOROUGHLY to appreciate the slight changes in the cornea which are capable of affecting the sight, the surgeon should clearly understand that the normal condition of the part consists in absolute transparency of its whole thickness, and perfect polish of its surface; every deviation from these conditions is an evidence of some morbid action.

When a healthy eye is examined near a window, the image of the window-frame ought to be depicted on the surface of the cornea with the most perfect sharpness and clearness of detail. A slight amount of inflammation, just enough to cause some thickening of the epithelium, destroys the brilliant polish, and causes the image of the window to appear blurred and dull, and the lines of the sash-bars crooked and wavy. This appearance is often important as giving notice that inflammation of other tissues of the eye may be going on; as in the early stage of Glaucoma, where this dull condition of the epithelium is always to be seen.

CONICAL CORNEA.

(*Hyperkeratosis*—the tissue of the cornea being erroneously supposed to be in excess; *Staphyloma corneæ pellucidum; Keratoconus.*)

This curious and rare* malformation consists in a change in the form of the cornea from a segment of a sphere to a cone, the transparency of the part remaining unaltered. There seems to be no peculiar constitution which predisposes to the affection. It is met with in both sexes; in persons apparently of good general health, as well as in the delicate and sickly: nor have I ever observed that any special employment, or mode of life, could be traced as the exciting cause.

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* That the disease is very rare may be seen by reference to a table which I contributed to the *London Journal of Medicine* (vol. ii. 1850), showing the number of cases of conical cornea occurring among the patients annually received at the Moorfields Hospital from 1819 to 1849.

The aspect of a patient with conical cornea is so peculiar, that when once seen, the affection can never afterwards be overlooked. The eye, viewed in front, has a brilliant and sparkling appearance, as if a tear were hanging just in front of the pupil. When seen in profile, the conical shape of the cornea is at once recognised. The position of the iris is unchanged, and its movements are perfectly natural; nor is any other tissue, except the cornea, observed to be affected. In saying that a conical cornea is perfectly transparent, I should modify the remark as far as concerns the extreme apex of the cone, which sometimes, when viewed closely, presents an appearance of slight opacity. In some cases this seems due to an actual haziness in the tissue itself; but the appearance is frequently caused by mere refraction of the rays of light. There seems no good reason for attributing this slight cloudiness of the apex of the cone to the friction of the lids.

The apex of the cone almost always corresponds to the centre of the cornea; but in very rare cases it has been observed to deviate from this position. The deformity usually begins when the patient is between twenty and thirty. At first he grows short-sighted, but as the change goes on, a remarkable refraction of the rays of light is produced; the flame of a candle appears surrounded with a halo, then it seems to be divided into a multitude of diverging rays, and sometimes, instead of a single flame, several flames are seen, arranged in a circle. When the last stage of conical deformity has been reached, the patient cannot read, even at the shortest focus.

In the few cases in which conical corneæ have been dissected, the apex of the cone has been found very much thinned. The mode in which the disease originates is at present quite unexplained; and in proportion to the obscurity which attends its cause have arisen the most varied suggestions for its treatment. Repeated evacuations of the aqueous humour, the same operation followed by pressure on the cornea, removal of the lens by extraction or solution, these, and perhaps other forms of operation, were formerly tried, but without benefit.

About thirty-three years ago, Tyrrell tried the effect of displacing the pupil towards the corneal margin. With the blunt hook he invented, he drew out a small piece of the iris, and cut it off, leaving a portion of the cut tissue entangled in the wound. His object was to bring the pupil opposite the flatter portion of the cone; but the result did not answer his expectations. A better form of this operation has been lately devised, whereby the pupil is transformed into a long narrow chink, reaching quite across the cornea. A small wound is made close to the corneal margin, a blunt hook or fine forceps is introduced, and the pupillary portion of the iris, having been drawn out, is tied with a fine ligature. (See *Iriodesis.*)

At a later period, when the corneal wound is healed, and the aqueous humour retained, a similar operation is performed on the opposite side of the cornea. This operation, should, I think, be limited to those extreme cases of conical deformity which cannot be palliated by any optical contrivance.

Slight cases are sometimes benefited by deeply concave glasses; but in the complete stage of the disease, the sight is little, if at all, aided by glasses of any kind. A small aperture, like a pin-hole, in a metallic plate, held close to the eye, will in most cases of confirmed conical deformity enable a patient to read at a focus of five or six inches, who previously had been unable to discern a letter. If, instead of a hole, a slit about three-quarters of an inch long and the thirtieth of an inch wide, be made in a metallic plate fixed into a spectacle-frame, a considerable extent of lateral vision is obtained, without any necessity for moving the head in the way which is necessary when objects are viewed merely through a small circular aperture. It was the benefit derived from this slit in a metallic diaphragm which suggested the operation of Iriodesis just described.

Quite ineffectual have been the lotions, the drops, the escharotics, which have been used in every possible variety. Their employment was justified by the expectation that local astringents might induce contraction in the tissue of the cornea; and if they failed to do this, they at least, if carefully used, could do no harm to the patient's system. But a plan of treatment was devised some years ago, which appears to be so utterly irrational, and is so fraught with mischief to the digestion and general health of the patient, that I cannot quit the present subject without a few words of warning against it. The plan consists in giving the patient a grain of tartar-emetic, or a scruple of sulphate of zinc, together with two, three, or four drachms of sulphate of magnesia, every day for a year, or even longer. How any patients could be found willing to submit to such treatment is perfectly astonishing. I have, however, seen several who had done so. One poor woman had punctually followed out this 'emeto-purgative plan' for one whole year, and for nine years longer had taken the mixture at intervals. She was a martyr to dyspepsia, as might well be imagined, and utterly broken down in general health. Her corneæ remained conical.

ARCUS SENILIS.

This term is by no means well chosen, for the change in the cornea which it implies commences long before old age can be said to have arrived, and by the time the patient has reached the age of sixty or seventy, the arc has usually been converted into a complete circle. Several years ago, Canton described the appearance as being due to a fatty degeneration of the peripheral portion of the cornea; and the term 'arcus adiposus' would therefore be well applied to its early stage, and 'annulus adiposus' to that condition in which the white ring completely encircles the cornea. In many persons past forty years of age, in some even at a much earlier period, an opaque whitish crescent may be observed skirting the margin of the cornea, either at its upper or lower part. This opaque crescent is the commencement of the so-called 'arcus senilis;' and on close inspection it will be seen that the opacity is not an extension of the white tissue of the sclerotic into that of the cornea, but that a narrow interval of partially clear cornea always intervenes between the two opaque structures. In some old persons, the circle assumes a chalky whiteness, and presents a very striking appearance.

'Arcus senilis' is considered by some observers to indicate the co-existence of fatty degeneration of the heart. As far as the eye itself is concerned, the change can be considered as of very little importance. It certainly does not, as has been asserted, in any way contra-indicate the operation of cataract by extraction; for I have many times carried my section through a strongly-marked 'arcus senilis,' and the wound has become quickly and firmly united.

INFLAMMATION OF THE CORNEA.

(*Keratitis*; *Corneitis.* The former of these terms—from κερατίτης, horny—is undoubtedly preferable to *Corneitis*, which is neither Greek nor Latin.)

The healthy cornea, as I have already observed, is of the most perfect transparency, and its surface smooth and brilliant in the highest degree. These qualities are lost as soon as the part becomes inflamed; a general haziness overspreads the whole structure, and the surface looks like a steamy glass.

If the inflammation be acute, a crescentic plexus of vessels will be seen passing from the edge of the cornea for some little distance—a line or more—into its substance. These vessels are so fine, and so closely set together, that they produce the appearance of a small patch of blood smeared upon the surface of the cornea. With a lens of an inch focus the individual vessels composing the plexus may be identified. This characteristic plexus sometimes involves a third or even a half of the corneal circumference.

A zone of pink vessels is always seen in the sclerotic adjacent to the cornea, whenever any form of active keratitis is present; this *sclerotic zone* also exists whenever the iris is inflamed. It is therefore always to be regarded as an important sign. As acute keratitis advances, some portion of the hazy cornea may become more decidedly opaque, and of a pale yellow tint; this shows that softening is going on, which may lead to actual giving way of the part. Intolerance of light and abundant secretion of tears accompany keratitis. The larger venous trunks of the conjunctiva become full and distended, but there is an absence of that fine vascular network in the conjunctiva which characterises ophthalmia.

One eye is usually attacked at a time, but the other may sooner or later become involved, and it very often happens that the second eye becomes inflamed just as the first is recovering.

Children and young persons are the most frequent subjects of keratitis, and the disease is rare after the age of twenty. The subjects of it are usually of a weakly, irritable constitution, often pale and anæmic; in some cases presenting the swollen cervical glands and other marks of scrofula.

The prognosis is favourable in proportion as the patient is young, and is seen at an early stage of the disease.

The mischievous and too common practice of keeping such patients confined to darkened rooms often induces a morbid irritability of the nervous system, and an intolerance of light, which is still farther aggravated by the irritating drops so unsparingly applied to eyes affected with corneal inflammation.

Under judicious management a case of keratitis occurring in a child may sometimes pass off without leaving a trace of opacity. But when the disease occurs after puberty, and is severe and obstinate, perfect transparency is hardly ever restored, and the cornea remains ever afterwards rather more convex than natural, and very faintly mottled with opacities and partially transparent interstices. These opacities resulting from long-continued keratitis, without ulceration, require to be thoroughly understood; for the surgeon who has not made himself familiar with their appearance will be sure to overrate the patient's powers of sight. It seems as if long-continued keratitis in patients who have passed childhood were attended with some peculiar change in the fibres of the cornea, whereby those portions which present only the slightest traces of opacity become, from irregular refraction of the rays of light, unable to transmit a clear and well-defined image of objects.

Treatment.—I have already alluded to the constitutional peculiarities commonly met with in patients who are the subjects of keratitis. They are in every way unfitted to endure the 'antiphlogistic' measures recommended in so many works on eye-diseases. The diet should be nutritious and abundant, but not given in such quantities as to oppress the stomach and impair digestion. Very young children are almost always better without beer or wine. The former should be given to older children once a-day if they have been accustomed to it; but wine can only be required by children suffering from extreme debility; in ordinary cases it hurries the circulation, and increases the general irritability of the nervous system. Of course the condition of the bowels is to be carefully attended to; and where the state of the biliary and other secretions may demand the use of mercury, an occasional dose of calomel—one or two grains, with or without a proportionate quantity of rhubarb—is to be given; but anything like a mercurial course is to be avoided. Iron is, of all substances, the most beneficial in cases of genuine keratitis, but it frequently fails in consequence of being given in too large doses, and for too long a time without any pause. The tinctura ferri sesquichloridi is the form I usually prefer, giving it invariably directly after food, or even during a meal, and in doses varying, according to age, from five to twelve drops twice a day. The syrupus ferri iodidi is sometimes useful. Occasionally, when the patient is feeble, ill-nourished, or of phthisical tendency, cod-liver oil may be given as well as the iron, or even, for a time, instead of it.

Counter-irritation, by means of small blisters to the temples, is often valuable in combating the intolerance of light; and tincture of iodine, applied to the skin of the lids, also conduces to the same end, and is preferable to blisters in patients of extreme delicacy of constitution.

Inflammation of the cornea is essentially a tedious disease, and the surgeon must often wait patiently for weeks, and even months, before the transparency of the part is restored. Hence it will be seen how necessary it is to give the tonic medicines in small doses, such as the patient can go on with for a considerable period, instead of attempting to conquer the disease at once by giving large doses, which cannot be persevered in without derangement of the stomach and liver.

Warm fomentations, night and morning, or steaming the eyes over hot water, will usually be found to allay their irritability; but all stimulating lotions and drops do harm.

How any one who has seen much ophthalmic practice can recommend the application of solid nitrate of silver to the conjunctiva in cases of keratitis, I cannot comprehend. The same substance in solution, and the sulphates of copper and zinc, are also frequently employed, and sometimes the ointments of the nitrate and nitrico-oxide of mercury are added, as if on purpose to increase the irritation already existing.

'Scrofulous or Strumous Ophthalmia' (so called).

At page 50 I have observed that the well-known disease commonly called Scrofulous Ophthalmia (*Phlyctænular Ophthalmia* of Mackenzie) derives all its importance from the fact that the cornea is implicated; and I therefore proposed to separate the disease from the group of conjunctival inflammations, to which alone the term 'Ophthalmia' strictly belongs, and to treat of it under the head of Inflammation of the Cornea.

It specially attacks children, but certainly is not always confined to those of scrofulous constitution; at least it is met with where there is no evidence of tubercular disease. The most striking symptom is extreme intolerance of light (*photophobia*), and general irritability of the eyes and of the whole system. The local affection of the cornea shows itself either in a small whitish elevation (*phlyctænula*), or an ulcer. In either case a long plexus of vessels runs from the corneal margin to the morbid spot. This long plexus or lash of vessels is quite diagnostic of the disease. It is sometimes seen when the rest of the cornea is almost clear, but more commonly there are several phlyctænulæ or ulcers, and the whole of the cornea is more or less hazy. The intolerance of light I have mentioned, as being characteristic of the disease, causes violent spasm of the orbicularis palpebrarum, which is increased when the surgeon makes any attempt to examine the eyes. The intolerance is often much increased by the too common but most injudicious practice of keeping the patients in dark rooms. After many hours of darkness, the sudden admission of light is of course extremely painful. If the intolerance is very great, or the child too young to be open to persuasion, the examination must be made by means of the wire speculum.

The pain caused by exposure to light is often out of all proportion to the extent of corneal disease. In some extreme cases the surgeon is surprised to find merely a small whitish elevation (*phlyctœnula*), or an ulcer the size of a pin's head, with the characteristic streak of vessels reaching to it from the edge of an almost clear cornea.

In true cases of this form of keratitis there is hardly any increase in the mucous secretion from the conjunctiva, but the flow of tears is profuse, and they gush out each time the lids are separated. There is a more or less marked zone of vessels in the sclerotic immediately around the cornea, but no general redness of the globe, the chief increase of vascularity being due to distension of the larger veins of the conjunctiva. The lids are often raw and excoriated at the edges, and the outer commissure is inclined to crack and bleed. Swollen and fissured lips and alæ nasi, excoriations and cracks behind the ears, eczema on various parts of the face, and eruptions on the scalp, are occasionally found to accompany this disease of the eyes in the more severe and long-continued cases.

Treatment.—Both the skill and patience of the surgeon are often severely tried by these cases, especially if they have been neglected, or treated injudiciously, before coming into his hands. Long-continued doses of mercury, seclusion in dark rooms involving the loss of air and exercise, and too much of food and stimulants, are the common sources of unsuccess as regards general management, whilst the local application is too often just that which is most hurtful—namely, nitrate of silver.

Under the head of Catarrhal Ophthalmia I have spoken of the valuable properties of this substance in solution, in cases where the inflammation is limited to the conjunctiva; and I have also mentioned how beneficially the application of the solid nitrate acts in arresting the rapid ulceration of the cornea in purulent or gonorrhœal ophthalmia. But the too common practice of dropping-in a solution of the nitrate in cases where the cornea is attacked either with phlyctænulæ or ulcers, is most mischievous, and often prevents the cure of a case which in other respects may have been judiciously treated.

I have said that children attacked with this disease should by no means be shut up in dark rooms. Light is as essential to the health of animals as of plants, and all inconvenience from bright light can be averted by the use of a large shade, or in elder children a pair of tinted spectacles. Out of doors a blue or green veil may be added. Moderate exercise in the open air should be taken whenever the weather is mild and dry, and sea-air is generally the most desirable, provided the place selected be not too bleak and windy. I have alluded to the ill effects of too much food and stimulants; but in doing so, I would not be supposed to recommend low diet: on the contrary, there should be an abundance of nutritious, easily-digested food. My remark was directed against that pernicious practice of stuffing young children with more animal food than the stomach can properly digest, and over-exciting their irritable circulation with wine and beer, as if their disease could, as it were, be taken by storm and extinguished by mere eating and drinking. Of course there are exceptional instances of very weakly children who require a small quantity of wine; but, as a rule, beer is preferable at an early age, and to those unaccustomed to stimulants pure milk will often be found of far more service.

With respect to drugs, I know of nothing so useful as iron in cases of keratitis, whether attended with phlyctænulæ or ulcers. It may be given alone, or in combination with quinine, according to circumstances. The reason why iron is so often ineffectually prescribed in this disease and in many others, appears to me to be, that it is given in too large doses and at wrong times. The form I prefer is the tinctura ferri sesquichloridi, in doses of 5, 10, or 12 drops, twice or thrice a day, to children ranging from five to fifteen years of age. It is best taken in water, and always immediately after a meal. Weakly children may at the same time take with advantage cod-liver oil. Every fortnight or so the iron may be discontinued for a couple of days, and if the bowels have become confined, or the liver appear to be deranged, a mild aperient may then be taken, with half a grain, a grain, or two grains of calomel, according to age and constitution.

Of local applications none are so generally employed as blisters; and no doubt, when used judiciously, they are very serviceable in subduing that intolerance of light which is one of the most distressing features of the disease. But here again a great mistake is frequently made in applying blisters of too large a size, and without sufficiently discriminating between those constitutions that will and those that will not bear them. In feeble anæmic subjects a blister, even of small size, will often produce considerable depression; and in very young children with irritable skin, will bring out a troublesome eczematous eruption. The best effect is produced by applying blisters the size of a shilling or a florin to the temple, allowing the part to heal quickly, and repeating the blister when the cuticle is reproduced at the end of a week or ten days. A more rapid form of counter-irritation is that produced by undiluted tincture of iodine, painted on the skin of the upper lid. This may be repeated as often as the skin recovers its natural condition.

The lids may be bathed night and morning with warm water, or the steam of hot water may be allowed to play against them, which avoids the mechanical irritation of rags or sponges.

Spermaceti-ointment, or fresh olive-oil, may be smeared along the eyelashes at bedtime. Lotions of acetate of lead, or alum, two or three grains to the ounce of water, are sometimes useful where there is on the cornea merely a small opaque patch (phlyctæna), with the characteristic lash of vessels running to it; but whenever an ulcer exists lead-lotions are improper, as the carbonate of lead, which is precipitated from them, is liable to form an insoluble white deposit in the cicatrix.

Leeches always do harm in cases of true keratitis with ulceration of the cornea. The barbarous proceeding termed 'scarification of the lids,' is, I hope, so nearly obsolete as not to require notice.

To get rid of the plexus of vessels running from the edge of the cornea to the phlyctænula or ulcer on its surface, it has been gravely proposed that the vessels should be cut across with a lancet. This is, indeed, beginning at the wrong end. '*Ubi stimulus, ibi affluxus*;' so long as an irritable patch of deposit, or an ulcer exists, so long will an irregular supply of blood be sent thither. Heal the ulcer, or get rid of the irritability of the cornea, by constitutional means, and the plexus of vessels will vanish.

The opacities remaining after a long-continued attack of scrofulous ophthalmia are, to a certain extent, permanent; that is to say, if they result from the healing of ulcers. But if the ulcer be superficial and the child very young, it is surprising to see how faint a trace remains in after-life, to mark the site of the cicatrix.

SYPHILITIC KERATITIS.

It is to the careful observations of Hutchinson, that we owe the true knowledge of this remarkable form of corneal inflammation. Not that he detected a disease which had never been seen before; on the contrary, it was in patients who might have been selected as affording typical specimens of 'strumous ophthalmia' that he first declared the morbid appearances to be due, not to scrofula, but to inherited syphilis. He named the disease 'chronic interstitial keratitis;' but I think we may fairly substitute the shorter term *syphilitic*. No confusion can arise from thus naming the disease, because there is no special form of corneal inflammation connected with acquired syphilis, the chronic interstitial form being met with exclusively as a sequela of an *inherited* taint.

The subjects of this form of keratitis are children and young persons from five to eighteen years of age, and most frequently it is an eldest child that comes under observation. The disease begins at the centre of one cornea, in the form of a diffused haziness, like that of ground glass. Very soon whitish dots appear in the midst of the haze, not on the surface, but in the very substance of the cornea. These dots generally run together, and thus increase the amount of central opacity. At first there is but little attendant vascularity of the sclerotic and conjunctiva, but as the central opacity becomes more marked, these tissues become reddened, and a fine plexus of vessels spreads on the cornea itself, and gradually pervades the opaque portion, affecting the upper and central part of the cornea in preference to its lower half. Throughout the whole course of the disease there is no tendency to ulceration.

Usually within about two months—or it may be much earlier —the other cornea begins to be affected, the disease commencing, as in the eye first attacked, by a central haziness.

The vascularity of the cornea, when the disease is at its height, is wholly unlike that which attends granular lids, and other chronic forms of keratitis. In the latter the vessels are large and superficial, whereas in the disease now under consideration they penetrate the cornea so deeply, and are so fine and closely set together, that the effect produced is that of a tissue infiltrated with blood.

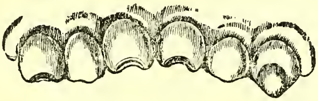
'In almost all cases the subjects of this keratitis,' says Hutchinson, 'present a very peculiar physiognomy, of which the most striking signs are, a coarse flabby skin, pits and scars on the face and forehead, cicatrices of old fissures at the angles of the mouth, sunken bridge to the nose, and a set of permanent teeth peculiar for their smallness, bad colour, and vertically notched edges.' He adds : 'As diagnostic of hereditary syphilis, various peculiarities are often presented by the other teeth, especially the canines, but the upper central incisors are the *test-teeth.* When first cut, these teeth are usually short, and the cutting edge is narrow from side to side, and very thin. After a while a crescentic portion from their edge breaks away, leaving a broad, shallow, vertical notch, which is permanent for some years, but between twenty and thirty usually becomes obliterated by the premature wearing down of the tooth.' . . . . . 'I have not met with a single example of well-characterised interstitial keratitis in which the teeth were of normal size and shape.'

More extensive experience has caused Mr. Hutchinson to modify this last remark, and he mentions several exceptional cases in which all the appearances of syphilitic keratitis were present, in association with well-formed teeth.

One very remarkable instance of keratitis—I think the severest I ever saw—occurred in my own practice, in a young lady whose teeth were quite remarkable for soundness and symmetry ; but in her the peculiar physiognomy was well marked, and her history completely confirmed the fact of her inherited syphilis. I have also seen some striking cases, in which patients with well-formed features, and clear and ruddy complexions, had strongly-marked syphilitic keratitis ; but their teeth were more or less affected. We therefore may meet with severe syphilitic keratitis in patients with healthy physiognomy and deformed teeth ; or—still more rarely—in those with faultless teeth and the syphilitic cast of features ; but to find the true form of keratitis in connection with both good teeth and good complexion also, is, I think, next to impossible.

I frequently notice that medical men who have not read Hutchinson's careful descriptions, but have only heard of 'notched teeth,' expect to find serrated edges, such as one so often sees in newly-cut healthy incisors. 'Serrated,' however, implies a series of notches. A single notch is that to which Hutchinson first drew attention; and the following figure, copied from his work, will at once show the reader what he is to look for.

Fig. 144.



In adults the notch often becomes worn away, but even then the tooth retains a characteristic shape. I liken it to that of a screw-driver, being wide at the base, where it joins the gum, and narrow at its cutting edge; while its lateral edges are thick and rounded. The lower incisors never lose their peculiar form, which is more or less cylindrical, and they are commonly wider apart than healthy teeth.

It must be always borne in mind that these syphilitic peculiarities in the teeth are only met with in the permanent set. The first set are not notched, but they are usually stunted and prone to premature decay.

Treatment.—A combined specific and tonic plan is advocated by Hutchinson, as being more efficacious than one exclusively tonic, and he advises the cautious use of mercurials and iodides. He prefers to administer the mercury by rubbing-in the milder ointment, always avoiding ptyalism, and gives internally iodide of potassium and iodide of iron.

I believe iron, under some form or other, to be the one drug needful. It should be given in small doses, because the cure is necessarily very slow, and the medicine must therefore be continued for many months. An occasional small dose of calomel—a grain or so once a fortnight—is requisite to prevent the iron deranging the liver, but I do not think 'a mercurial course,' as it is termed, either necessary or beneficial. The forms of iron I prefer are the tinctura ferri sesquichloridi, and syrup. ferri iodidi. For a young child six or seven years of age, eight or ten drops of the tincture, given once a day immediately after a meal, will be a full dose; each fortnight it may be left off for a day or two, and a grain of calomel given. Even for patients sixteen or eighteen years old, the dose of the tincture need never exceed fifteen or twenty drops.

Good diet, pure air, and all things calculated to improve the condition of the blood and tissues, are of the utmost importance in treating the cachectic subjects of inherited syphilis. The surgeon must ever bear in mind that the severer forms of syphilitic keratitis require a very long time for their cure. A bad case will require a year or even longer, and the friends of the patient ought at the very first to clearly understand this. A rapid cure is quite impossible. If only the vascularity of the cornea disappears, and from month to month the part becomes less opaque, the very worst case may terminate satisfactorily. It is, however, unreasonable to expect that in very severe cases absolute transparency of the cornea will ever be attained.

A very chronic kind of iritis commonly accompanies the severer forms of syphilitic keratitis, and the consequent deposits in the pupil, or around its margin, are first detected when the cornea is recovering its transparency.

Keratitis with Suppuration.

In simple inflammation of the cornea, the opacity, however dense it may be, consists of inflammatory exudation among the fibres of the part, without any destruction of the fibres themselves. Under certain conditions of the patient's system, however, the inflammation may run a very acute and rapid course, and within a few days terminate in suppuration or ulceration.

When suppuration takes place in the substance of the cornea, it is most frequently at the centre, or a little below that spot, that the pus collects. Its presence is usually manifested by a small yellowish patch in the midst of the general haziness. In very severe cases this yellow patch may rapidly spread, until the whole cornea assumes one uniform creamy tint, entirely hiding every trace of iris; the cornea then softens, and gives way at some part, the iris prolapses, and vision is eventually lost.

These are extreme cases: a more ordinary form of suppuration is that in which the pus gradually infiltrates the lower third, or even the lower half, of the cornea, and at last makes its way through the posterior elastic lamina, and then sinks down to the bottom of the anterior chamber, where it forms what is termed *hypopyon*.*

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* This collection of pus at the bottom of the anterior chamber is by some authors termed *onyx*; others use the latter word—now almost obsolete—to signify an abscess in the substance of the cornea.

The giving way of the posterior elastic lamina of the cornea is sometimes speedily followed by that of the anterior lamina, and in that case a perforation is established, through which a prolapsus of the iris takes place. This perforation of the cornea is followed by immediate relief of the severe pain which had existed as long as the pus was pent up among the fibres of the cornea, or in the anterior chamber. This pain is often severe to a degree quite incredible to those who have never witnessed such cases, assuming the form of neuralgia, and wholly preventing sleep.

Treatment.—In general surgery we are so accustomed, whenever an abscess forms, to regard its evacuation as the very first indication for treatment, that I may be expected to mention a puncture for giving exit to the pus, as the most important step in treating a case of suppuration in the cornea. But although it is common to speak of *abscess* in this part, the matter is not contained in a distinct cavity, but is infiltrated among the corneal fibres, so that if an incision be made, the pus does not flow out. The cornea, too, differs from every other superficial tissue of the body, in being transparent; and we should avoid inflicting any unnecessary wound, even to the smallest extent, upon a structure, the transparency of which is essential to sight.

The general tonic plan of treatment I have sketched out as suitable to cases of common keratitis will be applicable, with certain modifications, to keratitis with suppuration. We must take care not to reduce the patient's vital powers; for if we do, not only will the softening of the corneal tissue be likely to spread, but if perforation of the cornea takes place, there will be a deficiency of reparative material to fill up the breach, and a large prolapsus iridis, with consequent distortion or obliteration of the pupillary opening, will be the result.

In the very early stage of suppuration, when a small yellowish patch in the midst of the hazy cornea is all that is seen to mark the beginning of suppuration, blistering to the temple sometimes aids in checking the formation of pus; but when a considerable portion of the cornea has become infiltrated, and severe neuralgia sets in, blistering only aggravates the pain. Narcotics must then be given; to children, a few drops of tincture of hyoscyamus at bedtime; to adults, a fuller dose—ʒss. or ʒj. In very severe cases of neuralgia in the fifth nerve, hyoscyamus will be found unavailing, and morphia must be resorted to, especially if the patient be accustomed to the use of opium. Sometimes a piece of lint steeped in chloroform liniment, and laid upon the temple and forehead, over the region of the lacrymal and supraorbital branches of the fifth nerve, is of great service in lulling the pain.

If the infiltration and softening of the cornea go on to perforation, the aqueous humour at once drains away, and then the neuralgia usually ceases, or is mitigated in a remarkable degree. If the pain ceases, so as to allow the patient to obtain sleep without the aid of narcotics, they ought, as soon as possible, to be laid aside; for they almost invariably take away appetite, and the patient is now in need of good nourishment to hasten the repair of the breach in the cornea.

Bark and ammonia, or quinine, may be required at this stage of the disease; but a carefully-regulated nutritious diet, with a moderate amount of stimulants, must be the chief sources of the reparative process.

As respects local treatment, protection from light, and occasional fomentation with warm water or poppy-decoction, comprise all that is necessary during the earlier stage. When, however, the cornea has given way, the eyelids must be kept constantly closed, either by the application of a strip or two of plaster, or by means of a light pad of cotton-wool, arranged around the eyeball, and kept in its place by a bandage. The eye should only be opened occasionally by the surgeon, to ascertain the progress of repair. In some cases it is useful to abstain from examining the eye for four-and-twenty or eight-and-forty hours.

When prolapsus iridis has occurred, this occlusion of the eye is especially useful, as, by keeping the parts at rest, an opportunity is afforded for the adhesion of the protruded iris to the edges of the aperture in the cornea. As soon as this adhesion has taken place, no more iris can escape, and the prolapsed portion gradually shrinks, and flattens down to the level of the cicatrix. When, from want of vigour in the patient, the adhesive process is sluggish, it is sometimes useful lightly to touch the prolapsus with a point of nitrate of silver.

To attempt to return a portion of iris which has prolapsed through a loss of substance in the cornea, is utterly futile; for it will protrude again and again, so long as there exists an aperture for it to escape through.

Disease of the fifth nerve, caused either by pressure on its trunk, as it is emerging by the side of the pons Varolii, or by primary degeneration in the tissue of the nerve itself, will give rise to a form of keratitis with suppuration very similar to that described in the preceding pages. In the cases of disease of the fifth nerve which I have seen, this affection of the cornea has not come on during the neuralgic stage, but at a later period, when, in consequence of partial or total destruction of the trunk of the nerve, there has been anæsthesia of the parts supplied by the ophthalmic division. In three or four cases which I have watched, the whole cornea was not destroyed; but after perforation had occurred, the process of softening ceased, and reparation so far took place that eventually there remained only an opaque cicatrix in the cornea, to which a portion of the iris adhered.*

'Exanthematous Ophthalmia' (so called).

(*Post-febrile ulceration of the cornea; Ophthalmia morbillosa; Ophthalmia scarlatinosa; Ophthalmia variolosa; Ophthalmia erysipelatosa.*)

The various forms of ophthalmia accompanying the exanthemata have been described by some authors with considerable minuteness; but if we restrict the term ophthalmia to signify an inflammation of the conjuctiva, it is perhaps in measles only that any very marked ophthalmia can be said to occur. Taking place, as it does, at the onset of the attack, it is one of the most marked symptoms of the disease, but demands no special treatment. The really important affection connected with measles, is the *ulceration of the cornea*, which results from the general debility produced by the disease. This ulceration is commonly attributable to a neglect of tonic treatment after the inflammatory symptoms have passed away. Iron and quinine, alone or in combination, cod-liver oil, the various influences of fresh air and nutritious diet, are all to be put in requisition to avert or to heal these ulcerations.

Scarlatina, on account of the greater exhaustion of the powers of life which it induces, is still more likely than measles to be followed by ulcers of the cornea. In some extreme cases of this frightful disease, the corneæ lose their vitality, and entirely slough away. The same system of tonics and nutritious diet which I have mentioned as useful in averting the sequelæ of measles, would be still more urgently called for after an attack of scarlatina.

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* In a paper published in the eighteenth volume of the *Medico-Chirurgical Transactions*, 1845, I drew attention to the fact, that anæsthesia of the fifth nerve was far more frequent on the *left* than on the right side. In 1857 I forwarded to the editors of the French translation of Mackenzie's *Treatise* (vol. ii. p. 763) a note containing all the literary references to cases of anæsthesia of the fifth nerve which I had collected up to that time. The result of the analysis of fifty-one cases is as follows: in five patients the fifth nerve was affected on both sides; in thirteen the right nerve only was affected; while thirty-three patients had anæsthesia of the *left* nerve.

During erysipelas of the head and face, in the severe form, the lids are so completely closed by the swelling of the skin, as to hide the eyes from observation. In the stage of debility succeeding the attack, ulceration of the cornea may arise, as in the two diseases above mentioned; or the cornea may even slough, as in scarlatina.

Of all the exanthemata, small-pox produces the greatest damage to the eyes; and a large proportion of those persons whom we see with shrunken globes, or with their corneæ converted into chalk-like ciatrices, have lost their sight from the ulceration induced by this disease. It was formerly supposed that these opacities were produced by pustules on the cornea itself; but it has been ascertained that pustules never form on this part, the opacities being invariably the result of ulcers, caused by the extreme prostration which succeeds the inflammatory stage.*

Ulcers of the Cornea.

Under the various heads of *Purulent*, '*Scrofulous*,' and '*Exanthematous Ophthalmia*,' and in the section on *Keratitis*, I have mentioned the more formidable kinds of ulceration to which the cornea is liable. The cases, however, are very numerous in which corneal ulcers are developed in a more isolated manner than in any of the above mentioned diseases, being unattended with either purulent discharge from the conjunctiva, or general inflammation of the whole cornea.

Persons of all ages are liable to corneal ulceration. It is essentially a disease of debility, attacking those whose general power has been lowered by some exhausting illness, by bad or insufficient food, or some other depressing agency.

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* For this important fact we are indebted to the extended observations of Mr. Marson, at the Small-pox Hospital. He has lately published the results of his vast experience up to the present time. Among 15,000 cases of small-pox, he has seen twenty-six instances of pustules on the eye-ball; but they have invariably appeared on the conjunctiva, never on the cornea.

In persons of feeble reparative power, an ulcer, instead of healing up to the level of the healthy cornea, sometimes forms a slightly-depressed cicatrix. It is of course most important not to confound these two conditions, as is often done by those unaccustomed to the observation of eye-diseases. A recent ulcer, in which the destructive process is still going on, presents a sharply-cut, well-defined edge, with little, if any, surrounding opacity, and the excavation itself, as regards transparency, offers but little contrast to the sound cornea. An ulcer which is healing is always more or less opaque throughout, and there is a cloudy halo surrounding it; and if the ulcer be large, vessels will be seen running to it from the edge of the cornea. A depressed cicatrix, on the contrary, has its edges smoothly rounded off, and its area is slightly opaque; there is little, if any, cloudy halo surrounding it, and seldom any plexus of vessels going to it from the corneal margin. In some cases, however, a depressed cicatrix is supplied by a small vessel or two, the remains of the plexus which once carried the material necessary for the healing of the ulcer which preceded it.

If the progress of an ulcer be not arrested, it may eventually perforate the whole thickness of the cornea. The aqueous humour then escapes, the iris falls forwards, so that the anterior chamber becomes altogether obliterated, a portion of iris—large or small, according to the size of the perforation—protrudes through the opening, towards which also the pupil is displaced. If the prolapsus iridis be very large, the whole area of the pupil may be annihilated.

In rare cases the ulceration stops short at the posterior elastic lamina of the cornea, which, in consequence of the pressure from behind, is thrust forwards as an almost transparent vesicle, filling up the cavity of the ulcer. The term *hernia corneæ* has been applied to this protrusion. It would at once be distinguished from a *prolapsus iridis* by the retention of the aqueous humour, and the consequent persistence of the anterior chamber.

There is one remarkable form of corneal ulceration—which I have seen only two or three times—of a singularly destructive and intractable character. In all of the cases the patients were men who appeared by no means debilitated, as far as their general health was concerned. One eye only was attacked; the ulceration commencing at the edge of the cornea, rapidly formed a deep crescentic groove, which continued to deepen and extend itself, until it had completely isolated the central portion of the cornea, which was left standing up in high relief. This central portion eventually yielded to the ulcerative process, and sight was of course entirely lost. It was remarkable that in all the cases the posterior lamina of the cornea either remained unbroken, or was perforated to only a small extent. The form of ulceration was very similar to that accompanying gonorrhœal ophthalmia; but there was no trace of purulent discharge. There was very little pain or uneasiness, and the amount of redness in the conjunctiva and sclerotic was but trifling. Probably some change in the tissue of the vessels supplying the globe was the cause of this rapid and uncontrollable ulceration.

Treatment.—I have said that corneal ulcers are almost always a result of general debility, and therefore their cure is to be sought rather by improving the general power of the patient than by local application. The exception to this rule is formed by those cases in which the ulcer is very large, exhibiting a total want of reparative action, and by those cases terminating in prolapse of the iris. In both of these instances, the local use of the solid nitrate of silver is often a very serviceable adjunct to the general treatment.

The mischievous effects of lead lotions, when applied to ulcers of the cornea, have been already alluded to (p. 66); and solutions of nitrate of silver, if used for too long a time, will also give rise to insoluble deposits, and consequent opacities.

While everything tending to improve the general health is to be resorted to in cases of ulceration, the occasional use of warm water to the eyes is commonly the best local application. The eye should be kept lightly covered; and if there be intolerance of light, or much pain in the eye, complete closure of the lids is indicated. This closure is especially necessary when either the iris has prolapsed, or a hernia corneæ has taken place.

I have already (p. 72) said how useless must be the attempt to push back a portion of iris protruding through a corneal ulcer. If the little nodule of iris soon becomes coated with an opaque layer of adhesive deposit, simple closure of the lids, and support of the general power by suitable diet and tonics, will suffice to cause the protruded iris to become adherent to the edge of the ulcer; after which, no further prolapse will occur. But if the protruding iris, instead of becoming coated with lymph, retains its natural colour and fibrous appearance, a touch with a fine point of nitrate of silver will often set up sufficient inflammation to cause adhesive deposit to take place. In like manner the deep excavated ulcer, which sometimes forms in very anæmic and weakly persons, and threatens to perforate the cornea, or to destroy it by rapidly spreading all around its margin, may be arrested, and a healing disposition given to it, by lightly passing the solid nitrate over the whole excavation and edges of the ulcer.

OPACITIES OF THE CORNEA.

It is of the utmost importance as respects both prognosis and treatment, that the surgeon should make himself perfectly familiar with the varied appearances which corneal opacities assume. Without this knowledge, he will be constantly liable to deceive both himself and his patient, in promising the removal of opacities which are in their very nature permanent; or in pronouncing incurable, hazy conditions of the cornea, which, if promptly and skilfully treated, may be perfectly removed. To the latter class belong those cloudy opacities which I have described (p. 67) as overspreading the cornea in the slighter forms of simple keratitis. The short period, a few days or weeks, during which the cloudiness had existed, the presence of a vascular zone in the sclerotic, and some degree of irritability of the eye, would all point out the cloudiness of the cornea as being due to simple inflammatory deposit within its substance, which, under suitable treatment, may be so entirely dispersed as to leave the cornea in all its original transparency. If, on the other hand, the same amount of general haziness were known to have existed for a long time—say a year or more—if there were a total absence of sclerotic redness, and if the eye had long ceased to be irritable, the surgeon would know that the opaque condition of the cornea was incurable, and he would no longer attempt the use of stimulating lotions and ointments, which could only arouse fresh irritation and increase the existing mischief.

The haziness which sometimes remains after a severe and obstinate attack of keratitis, presents an appearance not easy to describe, but which the experience of a few cases will readily enable the surgeon to recognise again. There is a total absence of unnatural vascularity about the eye, but the whole cornea is slightly shaded with a faint haziness, with intervening spaces of almost transparent tissue, through which the colour and texture of the iris and the form of the pupil can be recognised, although not in their natural distinctness. The dimness of sight in these cases seems to be out of all proportion to the amount of opacity; and the patient can perhaps merely see black streaks when looking at a page of type.

The terms *nebula*, *albugo*, and *leucoma* have been applied to corneal opacities, according to their different degrees of density; the slighter forms being distinguished as *nebulæ; albugo* and *leucoma* signifying rather the white opacity of cicatrices. The edge of a *nebula* is gradually shaded off into the surrounding clear tissue; that of a cicatrix, at least one of old standing, is more or less abruptly defined. Where a prolapse of the iris has taken place through a corneal ulcer, the leucoma which results is marked in the centre by a small blackish spot.

Treatment.—As regards the prognosis of nebulæ, their possible improvement mainly depends upon the age of the patient. In infancy, it is quite astonishing to see how the rapid interchange of material which is then going on, will diminish both the extent and the density of even large cicatrices. In an infant attacked with purulent ophthalmia, a cicatrix may at first be so large as to occupy the central third of the cornea, and yet, in after-life, a mere cloudy speck may remain opposite the centre of the pupil. At a later period of life, nebulæ, which form as the cicatrices of superficial ulcers, are more permanent; but around the denser part of the speck there is always a certain amount of cloudiness, which slowly disappears The older the nebula, the more sharply defined is its margin.

Allusion has already been made to the permanent white deposit which occurs in corneal ulcers, when lotions containing lead have been employed. The metal is deposited in the state of carbonate, and forms a chalky-white layer on the ulcerated surface. Practice alone can enable the surgeon to recognise these old lead-deposits. They somewhat resemble a little patch of whitewash, their margin being sharply defined, and their surface often presenting minute cracks, through which the tissue of the cornea appears as dark lines. When the ulcer has been very superfical, and the metallic deposit lies just beneath the epithelium, the surgeon may sometimes succeed in scraping away the deposit; to do this, however, requires the utmost care and lightness of hand.

A very curious form of *calcareous deposit*—phosphate or carbonate of lime—between the cornea and its epithelium sometimes takes place without any previous inflammation. I believe this kind of deposit to be extremely rare, for, since I first noticed it in 1848,* I have seen only two other instances. From what I have already said concerning the nature of corneal opacities, the reader will perceive that when they are of old standing and unconnected with any existing inflammation, local treatment can avail but little. Setting aside those exceptional cases I have enumerated as removable by operation, the partial disappearance of old nebulæ is due to that change of material which is constantly going on in the human body, and which is so much more active in infancy and childhood than after the period of growth has terminated. The lotions, the drops, the vapours, the ointments, which crowd the pages of the older ophthalmic works, if not actually hurtful, as being likely to set up fresh irritation, are either altogether inert or at best they serve to amuse the patient while time is slowly clearing the opaque tissues.

INJURIES OF THE CORNEA.

Abrasion.—The epithelium covering the anterior surface of the cornea is liable to be torn or scratched by coming in contact with any rough substance; or a little flap of the epithelium may be partially detached and doubled down. Those who have not seen these slight cases of injury to the epithelium cannot imagine how much pain they produce, especially in persons of a sensitive nervous system. A clean cut directly through the cornea often causes far less pain than an abrasion of the epithelium so minute as to be scarcely discernible.

Within a short time after the epithelium has been injured, the sclerotic is often much injected, and a profuse flow of tears follows every attempt to separate the lids. The surgeon will best obtain a view of the part by placing the patient in a chair and standing behind him. As soon as the lids are widely separated, the pain almost ceases, and the surgeon must then carefully explore the whole surface of the cornea, while the patient moves the eye in various directions, so as to allow a bright light to fall on each portion in succession. A slight irregularity and roughness at one minute spot is often all that can be found to mark the position of the injury.

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* My case was first published in the Appendix to Bowman's *Lectures on the Anatomy of the Eye*, 1849; and a second time in my *Guide to the Practical Study of Diseases of the Eye*, 1855.

The *treatment* of these abrasions is very simple. A drop or two of olive-oil or castor-oil may be applied to the abraded surface, and then the lids are to be kept closed with a light pad of cotton-wool, and a bandage, for four-and-twenty hours. As soon as the epithelium is regenerated all irritation ceases, and the uniform polish of the cornea is restored.

Contusion of the cornea.—Blows on the cornea which do not cut or lacerate, but merely bruise, its tissue, vary greatly in their results, according to the violence of the blow, and the age and vigour of the patient. In the severer forms of contusion, softening and suppuration among the fibres of the cornea will probably occur, and the part will afterwards exhibit more or less haziness. But in very feeble or old persons, the whole cornea may become softened and infiltrated with pus, and in such cases the pain is often very severe.

At length the cornea gives way, the aqueous humour escapes, and the pain immediately subsides; but the whole or the greater part of the cornea becomes pulpy and disintegrated, and comes away in shreds, and ultimately the globe shrinks, or else a staphyloma is formed. The worst cases of this kind occur among paupers engaged in stone-breaking. During such work, a pair of gauze-wire goggles should always be worn.

Treatment.—Even a slight contusion, if it takes effect at the centre of the cornea, must be regarded as a serious accident, on account of the suppuration and consequent haziness that may possibly ensue. We must take care, therefore, not to reduce the patient by bleeding and mercury, since by so doing the vitality of the cornea is lowered, and softening and suppuration are more likely to take place. An eye which has received a blow on the cornea should be kept closed and defended from light, and poppy fomentation may be used, if any pain comes on. If the case be seen early, a blister to the temple is sometimes useful as a counter-irritant. A narcotic may be required at bedtime; and the diet should not be reduced below that which is suited to the patient's ordinary condition.

The setting-in of suppuration, attended as it is with pain, would require an increased dose of the narcotic; and should the cornea give way, a tonic treatment, with a suitable proportion of stimulants, would become necessary, to limit the destruction of tissue, and afford material for repair.

Incised and punctured wounds.—Although cuts of the cornea are usually produced by sharp-edged or pointed bodies, they also occasionally result from sudden blows inflicted with blunt ones; and a smart stroke with a stick will sometimes inflict on the cornea a cut as clean as if made with a knife. Wounds of this latter description, however, on account of the shock given to the whole eye, are usually much more serious than those made with sharp instruments. A wound involving one-half of the corneal margin, such for instance as is made in the operation of extraction, may become completely united within three or four days, without inflammation occurring in any other tissue of the eyeball, whilst a much smaller cut produced by a blow with a stick or stone will be followed by severe and long-continued inflammation, ending in complete disorganisation of the globe. Small sharp bodies, such as fragments of metal or glass, when driven with great force and rapidity against the cornea, frequently produce so small a wound, that a surgeon unaccustomed to see such cases may be apt to underrate the size of the foreign body which has inflicted the injury; the elasticity of the corneal tissue causing the wound to contract as soon as the foreign body has passed through. When a case of this kind is seen immediately after the injury, the most careful scrutiny, with all the advantages of a good light, is often required to enable the surgeon to detect the wound. The whole surface of the iris, and especially the bottom of the anterior chamber, should be most carefully examined, in order to detect the lodgment of the penetrating body; and if the cornea be still transparent, and the aqueous humour retained, the pupil may be dilated with atropine, and the lens and deeper tissues explored with the ophthalmoscope. If any portion of the penetrating body protrude from the wound, it should be at once extracted with a fine well-closing forceps, the lids being held apart with a spring speculum, and the globe steadied by nipping up a fold of the conjunctiva covering the sclerotic.

When the wound of the cornea is large, a portion of the iris is frequently forced through the wound. If such a case is seen within a few hours of the accident, and before there has been time enough for the protruded iris to become united to the margins of the corneal wound by adhesive deposit, the portion of iris may sometimes be returned by careful pressure with a probe or small spatula. If, however, adhesion between the cornea and iris has already taken place, this reduction is impossible; and the surgeon must then content himself with maintaining the parts in perfect rest by keeping the lids closed; or if the protruding and strangulated iris be indisposed to shrink, it may be lightly touched with nitrate of silver, and the lids again kept closed for some hours.

Sometimes the protruded portion of iris gradually becomes distended with aqueous humour, and assumes a rounded pouch-like form. This little pouch should be freely punctured, or a portion of it cut off with curved scissors, and then the nitrate of silver and the bandage applied as before.

The advice I have here given, as to returning the iris protruding through an incised wound of the cornea, may at first appear to be inconsistent with what I have before said, at page 72; but the difference between the two cases consists in this—that when an ulcer has perforated the cornea, there is an actual loss of its substance, and if the iris protruding through such an aperture be pushed back, it will escape again and again. But in the case of an incised wound there is no loss of corneal tissue, merely a separation of its fibres; and if the protruding iris be returned into the anterior chamber, the elasticity of the corneal tissue will bring the edges of the wound into apposition, and keep them so until they have become united.

Punctured wounds of the cornea vary much in their character, accordingly as they are inflicted by means of pointed bodies of a large size, or by such small fragments as remain embedded among the fibres of the part. Wounds of the former class frequently involve other parts of the eye, and penetrate through the cornea into the iris or the lens. These complicated injuries cause either iritis or cataract, and will be spoken of in future chapters.

The simplest and by far the most common form of puncture of the cornea is that which happens when little fragments of metal or grit are forcibly projected against the eye, and remain sticking either in the epithelium or in the superficial layer of the cornea itself. Engineers, metal-turners, mill-stone dressers, stokers, are constantly liable to these injuries; and the surgeon should be able at once to remove the foreign body without inflicting in the attempt any farther injury on the cornea. Standing behind the patient, who should be seated opposite a window, the surgeon raises the upper lid by placing the tips of his first and second fingers against the edge of the tarsus, beneath the cilia, and then pressing the lid upwards and backwards without everting it; he then with these two fingers steadies the globe by gentle pressure just above the cornea, while the point of the ring-finger gently presses the globe at its inner side. In the other hand he holds a little spatula-shaped instrument (which for want of a better name I have called a 'spud'), the flat end of which he passes under the foreign body, and so tilts it out. The point of a cataract-needle or a lancet, on account of its fineness and delicacy, is very unsuitable for extracting these little bodies. All the treatment necessary after their removal consists in keeping the eye closed for a day or so, with perhaps occasional fomentation.

If an elongated chip of metal strikes the eye obliquely, it sometimes wedges itself into the cornea at about the middle of its thickness, lying exposed to view, but so completely buried as to afford no hold to a forceps. The surgeon must with a cataract-knife or cutting-needle slit up the layer of corneal substance along the whole length of the foreign body, which can then be turned out without difficulty.

One of the injuries most difficult to treat is that inflicted by a sharp-pointed chip of metal just long enough to transfix the cornea, and to thrust its point into the anterior chamber, while the other extremity is so much embedded as to offer no hold for a forceps. If the surgeon attempts to dig out such a chip, he will almost certainly drive it farther in, until at last it slips wholly into the anterior chamber, and entangles itself among the fibres of the iris.

The removal of the foreign body will call for all the operator's skill and patience, and chloroform must be used if the patient be timid and unsteady. The lids being separated with the spring speculum, an assistant fixes the globe by nipping up with a forceps a fold of the conjunctiva at its lower part. The surgeon then, with a broad cutting-needle, makes an opening in the cornea close to its outer margin. The needle should be slowly withdrawn, without rotating it in the slightest degree, so that the aqueous humour may, as far as possible, be retained. Then a small spatula is to be passed in at the opening, and carried quickly and steadily across the anterior chamber, so as to interpose between the lens and the intruding point of the foreign body. The spatula is then to be pressed forward against the foreign body to keep it fixed, while, with a cataract-knife or cutting-needle held in the other hand, the surgeon slightly enlarges the wound on the anterior surface of the cornea. Still steadying the point of the foreign body with the spatula in the anterior chamber, he endeavours with a very fine and well-closing forceps, to grasp the extremity of the foreign body and draw it out of the wound.

I have had occasion several times to perform this operation, which the minuteness of the foreign body, its close proximity to the transparent lens, and the necessity for limiting the extension of the external wound, combine to render one of the most difficult in ophthalmic surgery.

A foreign body, which passes quite through the cornea, may wound the lens and remain embedded in its substance, producing a traumatic cataract; or it may become fixed in the iris; or, having lost its momentum in traversing the cornea, it may fall down to the bottom of the anterior chamber. Under any of these conditions, if the surgeon sees the case immediately after the accident, while the cornea is still clear, and the iris and anterior chamber are not yet obscured by inflammatory effusions, he should endeavour at once to extract the foreign body. If it can be distinctly seen sticking in the lens, it will be right to make a section of the upper half of the cornea, and remove the lens, as in the ordinary operation for cataract. A chip of metal, fixed in the iris, may be removed with Assalini's spring-forceps,* or the cannula-forceps, introduced through a small corneal wound; and in the same manner foreign bodies of any kind, which are lying loose in the anterior chamber, may be seized and extracted.

The surgeon must not be deterred from attempting to remove these foreign bodies by the stories he will find in many of the older ophthalmic works, about the oxidation, and solution, or encysting of metallic fragments. The lymph which is thrown out around a metallic chip in the iris does indeed, for a time, encase it and hide it from view; but this is only the beginning of a tedious iritis, which will probably end in disorganisation of the eye, or, at least, produce obstruction of the pupil and loss of sight.†

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* This instrument was invented by Assalini for seizing the iris in the operation for artificial pupil; *Ricerche sulle pupille artificiali*, &c. Milano, 1811. For this purpose it has been superseded by the more delicate *cannula-forceps*.

† In a case I communicated to the *Dublin Journal of Medical Science* (n. s. vol. vi. p. 210, 1848), a very minute scale of copper remained fixed in the iris for *eight years*, and, after causing repeated attacks of iritis, was at last thrust forwards against the cornea by the effused lymph; ulceration was set up, and the little fragment, projecting through the cornea, was seized and extracted.

Foreign bodies lying loose in the anterior chamber are to be removed in a similar way to that I have just recommended in the case of bodies fixed in the iris; the extent of the corneal incision being of course proportioned to the bulk of the body to be extracted.

This may perhaps be the most convenient place to notice those rare cases in which a living entozoon constitutes the foreign body in the anterior chamber.

The *Cysticercus telæ cellulosæ* has been repeatedly met with in this situation, as a rounded, semi-transparent, vesicular body, furnished with a long retractile neck, terminating in a head furnished with suckers and a circlet of hooks. If not removed, the animal eventually sets up inflammation of the iris and cornea, which ends in total loss of vision. A crescentic incision along the edge of the cornea allows of the escape of the animal along with the aqueous humour. Cases have been reported by many ophthalmic writers, among whom Mackenzie has given the fullest details, and has figured the animal both in its natural condition and magnified.*

All the operations on the cornea just described will be greatly facilitated by the use of the spring speculum, a forceps to fix the globe, and, in irritable and timid patients, by the administration of chloroform.

The *after-treatment* of all the foregoing cases, in which an incision of the cornea may have been necessary for the removal of a penetrating body, mainly consists in keeping the eye perfectly at rest and protected from light, while the healing process is going on. For the first twenty-four hours at least, *both* eyes should be covered with a light bandage. After that period it may be sufficient to keep the wounded eye closed, and the length of time during which this closure should be maintained must depend upon the rapidity with which the wound heals, and the aqueous humour is resecreted—circumstances varying according to the constitution of the patient, and the amount of violence inflicted on the eye by the accident and the subsequent manipulations of the surgeon. Patients should neither be kept low nor over-stimulated, but maintained as near as possible at their natural standard of vigour. Those of an irritable temperament will often require a narcotic for several nights after these operations; but if chloroform has been used a narcotic should not be given while the system is still under the effects of the inhaled vapour.

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* Mackenzie (*Practical Treatise*, &c. 4th edit. 1854) quotes a case of *cysticercus* in the anterior chamber, observed by Schott in 1830; another by Logan in 1833; and relates two cases of his own in 1848 and 1850, and two others in the practice of other surgeons. He also mentions a case reported by Appia, in which the cysticercus is *said* to have been seen within the substance of the cornea. In all these instances the *left* eye was affected, and Mackenzie remarks that 'the left has suffered much oftener than the right eye from the intrusion of *cysticerci*, either under the conjunctiva or into the interior of the organ.' Cases which have been reported subsequently to the publication of Mackenzie's work do not, however, bear out this statement. In the *Archiv für Ophthalmologie*, vol. i. p. 453, is a case of *cysticercus* in the *right* anterior chamber; and in the same journal, vol. iv. p. 113, is another, also in the right eye; Teale has reported a case occurring in the right eye; *Ophthalmic Hospital Reports*, vol. v. p. 320. When Mackenzie wrote, *cysticerci* had never been discovered in the *vitreous* chamber; but in the *Archiv* twenty cases have already been reported, nearly equally divided between the right and left eyes. (See a subsequent note on *cysticerci* on the retina and in the vitreous humour.)

CHAPTER V.

DISEASES OF THE SCLEROTIC.

INFLAMMATION.

(*Rheumatic Ophthalmia* of Mackenzie; *Scleritis*; *Sclerotitis.*)

THE sclerotic is inflamed to a certain extent in all cases of keratitis and iritis, and exhibits that zone of red vessels close around the margin of the cornea which is so marked a symptom of both these diseases. A more extended inflammation of the sclerotic not uncommonly forms one of the complications of catarrhal ophthalmia.

But there is also a form of inflammation which is almost limited to the sclerotic, the conjunctiva being implicated only in a secondary degree, and this sclerotic inflammation may assume either the acute or the chronic form.

In the acute inflammation the whole of the sclerotic is intensely injected, the part assuming a peculiar pink tint, quite different from the more vermilion colour of conjunctival inflammation. In very severe cases the pink tint has a shade of violet, in consequence of the depth at which the vessels lie in the fibrous tissue. Intolerance of light and lacrymation are marked symptoms, and in and around the eyeball there is always considerable pain, which sometimes assumes the form of intense neuralgia throughout the ophthalmic division of the fifth nerve, extending even into the second and third divisions.

The attack is attended with general constitutional derangement; the tongue is coated, the appetite bad, and the urine often deposits large quantities of lithates.

Treatment.—The bowels must be first thoroughly cleared, and then narcotics given, in doses proportioned to the severity of the neuralgia and the former habits of the patient. Half a drachm, or a drachm, of tincture of hyoscyamus may be sufficient in some cases, while in others full doses of morphia will be requisite to insure sleep. In some patients quinine, in others iodide of potassium, is of great service; to those in whom the rheumatic diathesis is more marked, colchicum given in combination with an alkali will be far more beneficial. The patient's appetite is usually so bad that it requires management to induce him to take sufficient nourishment. Beef-tea, bread-and-milk, and various modifications of farinaceous food, are often more readily taken than solid meat. Sugar should be avoided, and beer, as containing sugar; dry wine or diluted spirit being substituted, and of course only given in quantities demanded by the condition and previous habits of the patient. Local depletion by means of leeches seldom produces more than temporary benefit, and blisters only aggravate the neuralgia. Steaming the eyes over hot water is usually soothing, and preferable to fomentation, in consequence of the extreme irritability of the surface of the eye. The most effectual local application is chloroform, diluted with olive-oil according to the susceptibility of the skin, and applied on lint to the temple and forehead. The patient's room should be moderately shaded from light, and the eyes still farther protected, if necessary, by a suitable eye-shade, or tinted spectacles; but complete darkening of the room is unnecessary, and it has the great disadvantage of rendering the examination of the eyes by the surgeon intensely painful during the abrupt transition from darkness to light.

Chronic inflammation of the sclerotic occurs frequently, but by no means exclusively, in rheumatic subjects. Instead of involving the whole extent of the sclerotic at once, it commonly appears as a limited patch of redness, close to the cornea, after a time fading away, and then reappearing on some other portion of the white of the eye, but always keeping close to the corneal margin.

When this chronic inflammation of the sclerotic has gone on for a long time, it has a tendency to involve either the cornea or the iris. In the latter case the iritis is so insidious and so slightly marked as frequently to be overlooked; and it is not until after the sclerotic redness has wholly disappeared that some dimness of vision induces the surgeon to make a careful examination of the pupil; when he will probably detect some small adhesions between the iris and the capsule of the lens, or a filmy opacity of the latter, dotted with minute patches of pigment.

It appears to be this form of obstinate sclerotic inflammation which Wilde* has described as 'inflammation of the ciliary body.' No evidence, however, exists that this structure is specially the seat of inflammation.

Treatment.—Chronic inflammation of the sclerotic is a very tedious affection, and one that is extremely liable to recur, if the patients are exposed to cold and damp, or fall into that dyspeptic condition which induces chronic rheumatism. Strict attention to diet, avoidance of sugar, and substances which form sugar in the system, a dry and temperate climate, will be the best means to prevent the sclerotic inflammation from becoming periodical in its return. Quinine is commonly the most effectual remedy, and blisters to the temples are often valuable adjuncts. But if the patches of redness shift about from one side to the other, fading away at one part, only to reappear at an opposite point of the globe, a vigilant watch should be kept upon the iris, lest it should be attacked with inflammation. If the pupil becomes sluggish and slightly irregular, a careful examination with concentrated light will probably reveal a very slight, barely perceptible, deposit of lymph fringing the pupillary margin. The sight will at the same time be more or less cloudy. In such a case mercury must be carefully given to check the iritis. Two grains of calomel with half a grain of opium may be given at bedtime; or, if the iritis be more acute, and the deposit of fibrin more considerable, the calomel and opium may be given for a few days, night and morning; and as soon as the deposit begins to be absorbed, the dose may be restricted to two grains a day, or even that quantity may be given on alternate days. In delicate subjects a single grain taken every night may be sufficient from the first. The mouth must never be made at all tender, and the depressing influence of the mercury may be counteracted by a daily dose of bark, and a moderately nutritious diet. The bark should be continued in small doses for some weeks after the mercury has been left off.

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* *Medical Times and Gazette,* n. s. vol. ix. p. 515, 1854.

Injuries of the Sclerotic.

Clean cuts of the sclerotic, inflicted with sharp bodies of various kinds, frequently involve the subjacent structures, the choroid and retina. If the latter be extensively divided, a greater or less quantity of the vitreous humour is almost sure to be lost. The laxity of the conjunctiva, however, often serves to limit the escape, as the tenacious fluid becomes entangled among the meshes of the sub-conjunctival areolar tissue.

The prognosis of wounds of the sclerotic depends upon their extent, the amount of vitreous humour which has been lost, and, above all, upon the fact whether or not the foreign body inflicting the wound has penetrated into the interior of the globe. The wound made by the entrance of a grain of shot is usually very small, as the elasticity of the sclerotic causes its fibres, after being separated by the shot, instantly to close up again, as soon as it had passed through them. When quite recent, a shot-wound in the sclerotic is hidden by a little patch of blood extravasated beneath the conjunctiva. The entrance of a grain of shot, or a fragment of metal, through the sclerotic into the vitreous chamber is almost certain to set up a slow inflammation of the whole globe, ending in loss of sight and atrophy of the organ.

Simple punctures and small cuts through the sclerotic, unattended with the retention of any foreign body, commonly unite very well, provided the eye be kept in perfect rest, and the reparative process be not interfered with, and checked by injudicious applications, or by general depletion and weakening of the patient's system. It seems almost superfluous to insist upon the necessity for absolute repose for the wounded organ; and yet it is wonderful to see how the good sense of the surgeon, who would treat a fractured limb on the principle I have just mentioned, seems to desert him as soon as a wounded eye comes under his care.

Rupture of the sclerotic with displacement of the lens.—A very remarkable injury sometimes happens to the sclerotic, consisting in a laceration extending completely through its substance, within a line or two of the corneal margin, while the conjunctiva remains unbroken, and the dislocated lens, slipping out through the rent in the sclerotic, becomes firmly wedged beneath the conjunctiva.

This rupture of the sclerotic always takes place on the side of the eye opposite to that which has received a severe blow with some blunt body; the fibres, being suddenly put on the stretch, give way at the point where they are the most bent. Hence it is that the seat of rupture is almost always either the upper or the inner part of the globe, the lower and the outer portions being comparatively exposed to violence, while the prominence of the eyebrow above, and of the nose internally, defends the upper and the inner portions.

Rupture of the sclerotic, with sub-conjunctival dislocation of the lens, is always attended with some injury to the iris. Either that portion adjacent to the sclerotic wound is drawn into it, the pupil remaining large, and displaced towards the margin of the cornea, or else the shock causes the ciliary attachment of the iris to give way to a greater or less extent.

It sometimes even happens that the whole ciliary attachment gives way, and the entire iris is driven completely out of the globe, through the rent in the sclerotic, along with the aqueous humour, lens, and a portion of the vitreous body. This large escape of the contents of the globe only takes place, I believe, when the conjunctiva is also ruptured.*

When a recent case of ruptured globe is seen soon after the infliction of the injury, the parts are so obscured by blood that it is often impossible to form a correct estimate of the damage the globe has sustained. Detachment of the iris from its ciliary connection is always attended with bleeding, which may completely hide everything behind the cornea. The lens, too, if dislocated beneath the conjunctiva, is often enveloped in blood, so that its form cannot be precisely defined. Until the blood behind the cornea has been absorbed, it is impossible to ascertain whether the retina has retained its function; so that in every case the prognosis will be extremely doubtful.

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* See two cases in which the lens and iris were driven out of the eye through the ruptured sclerotic, published in my *Practical Guide*, &c., 2nd edit., pp. 398–9. Also a case of sub-conjunctival dislocation of both lenses in the same person, p. 113, *note*.

Treatment.—If the detached iris is hanging out of the wound through a rent in the conjunctiva, it should be snipped off with scissors; but inasmuch as the lens, if lying between the unbroken conjunctiva and the sclerotic, may be so obscured by effused blood as to be with difficulty recognised, it will be well to wait a few days until the blood has become absorbed, and then the division of the conjunctiva covering the displaced lens will allow of its easy removal.

Absolute rest of the eye is the one important point in the treatment of all cases of ruptured globe. For the first few days, both eyes should be kept closed, by means of strips of plaster or a light bandage. Afterwards, it will suffice to close the injured eye only; but this closure should be uninterruptedly maintained for a week or ten days.

The patient should not be kept on low diet, nor depleted in any way; least of all should he be brought under the action of mercury, as is too often done. Such treatment can only have the effect of lowering his reparative power, and so retarding the process of cure.

CHAPTER VI.

DISEASES OF THE IRIS.

Congenital Defects.

(*Irideremia; Coloboma; Misplaced pupil; Persistence of membrana pupillaris.*)

Congenital absence of iris (*irideremia*) always attracts the notice of those about the infant by the peculiar reddish glow which is reflected from the retina. The child seems to shrink from strong light, and there is a good deal of unsteadiness of the globes. The whole space behind the cornea presents one uniform red or orange tint, while the edge of the lens is marked out by a ring of golden light.

Although the term *irideremia* would imply a total absence of iris, a slight rudiment of it is often found, forming a very narrow segment of a circle skirting some portion of the edge of the cornea.

Considering that a certain number of infants affected with this rare malformation are yearly brought for an opinion to our public eye-hospitals, it is singular that an adult thus affected is so seldom met with. I can only remember to have seen one such case, a short notice of which I published a few years ago.*

Coloboma.—This congenital malformation is the result of an arrest of development, whereby the coalescence of the two halves of the iris is prevented; the pupil, therefore, presents an elongated form, and extends down to the lower edge of the cornea.

A median fissure of the lower portion of the choroid accompanies *Coloboma iridis.* The iris and choroid being formed in the embryo from one vascular membrane curved upon itself, an arrest of development causes in both structures the same kind of defect along the median plane of the eyeball.

Coloboma iridis, however, is not always placed exactly on the median plane of the eye, but sometimes a little to the inner or outer side of it. It usually co-exists in both eyes, although not always in the same degree. Sometimes, instead of the pupil being prolonged down to the bottom of the cornea, an abortive attempt, as it were, to form a coloboma is evidenced by a puckered groove in the iris, extending downwards from the lower edge of the pupil. The actual size of the pupillary aperture in coloboma is not always quite so great as, on a superficial inspection, it appears to be; for the extreme edge of the aperture, when minutely examined, will sometimes be found to be fringed with a blackish-brown pigment; and this at first sight produces the effect of a larger area than really exists.

An old prolapse of the iris through an ulcer, situated at the lower edge of the cornea, by drawing the pupil directly downwards, may produce an appearance a good deal like a *coloboma*

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* *Guide to the Practical Study*, &c. 2nd edit. p. 400. Samuelson describes a case of *irideremia* in a man of forty-eight. Not only were the irides absent, but the closest scrutiny failed to detect any ciliary processes. His accommodation seems not to have been tested; but he asserted it to be perfect; *British Med. Journal*, 1863, p. 495. In the *Monatsbl. für Augenheilk.* 1866, *irideremia* is noticed as existing in a woman of forty-two. Her eldest child had the same defect. Hulme reports a case in a man aged twenty-two. He could read No. 6 of Jæger's test-types; *Med.-Chir. Trans.* vol. xliv. France gives another case, a woman aged twenty-three; *Guy's Hospital Reports*, vol. vii.

iridis. The white cicatrix, however, in the former case, would always enable the careful surgeon to recognise the true character of the deformity.

Another abnormal condition of the pupils consists in their being placed near the margin of the cornea, instead of opposite to its centre. Mal-position of the lens appears frequently to accompany this eccentric position of the pupils.*

Persistence of the fœtal *membrana pupillaris* has been described as sometimes causing an obstruction in the pupil which might be mistaken for congenital cataract; but no practised observer could make such a mistake; for the *membrana pupillaris* is attached, not to the margin of the pupil, but to the anterior face of the iris, at a little distance beyond, where there is a more or less elevated ring of small tufts or nodules. Projecting from this part of the iris, I have occasionally seen slight vestiges of the pupillary membrane, in the form of little spurs or tags.

The persistence of any portion of this membrane, even in young persons, is a circumstance of extreme rarity. Dr. Cohn, in the *Klinische Monatsblätter für Augenheilkunde*, 1867 (p. 62), enters into an analysis of the cases published by different authors, and dismisses all of them except five as originating in a faulty diagnosis. He describes four cases from his own observation. I think there can be no doubt that, in most of the instances reported, old adhesions, the result of bygone iritis, have been mistaken for shreds of the membrana pupillaris.

The following case appears to be worthy of record, as exhibiting a vestige of the pupillary membrane in a person of middle life.

In the summer of 1867, a lady, aged thirty, consulted me for short-sightedness. The case was a very simple one, the myopia not in any high degree, and suitable glasses were all she required. I noticed a fine hair-like thread running obliquely across the pupil of the right eye, and at once recognised it as a vestige of pupillary membrane. It gave the patient no inconvenience, and indeed she could not be made aware of its existence under any illumination I could apply. Fig. *a* represents the eye with the pupil in its natural state, and Fig. *b* after atropine. I had expected to find that, as the pupil dilated, while the two sides of the iris were held together by the little thread, the aperture would become irregular; but this was not the case to any appreciable extent. The iris, of a thoroughly healthy appearance, was of a rust-brown, and the filament was only a little paler in colour. At each end it had a bifid attachment, and looked like a portion of the proper fibrous tissue of the iris drawn out into a thread. Under the ophthalmoscope, the media and fundus of the eye presented nothing unusual.*

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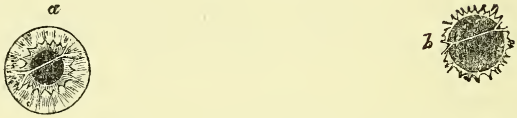
* Figures of unusually extensive coloboma iridis, and of congenital mal-position of the pupils, illustrate a paper of mine in the *Ophthalmic Hospital Reports* for 1858 (plate iv. figs. 2 and 3).

FIG. 145.



In the *Albino* the iris partakes of the general want of coloured pigment which characterises the hair and skin. The layer of opaque pigment, termed *uvea*, is altogether wanting, and the structure of the iris presents a singular appearance, as if loosened by maceration. Whitish fibres are intermixed with others of a lilac colour, and through the whole attenuated iris the light reflected from the fundus of the eye transmits a reddish glow.

Albinism is frequently attended with defective vision, and always with great intolerance of light. In some cases, however, sight is very good, and extreme sensibility to light is the only thing complained of.

INFLAMMATION OF THE IRIS—IRITIS.

Before entering upon this very important subject, it will be desirable to say a few words about the appearances which the iris presents in a healthy state; for it is subject to many variations as to colour and mobility, which, if not rightly understood, may lead to serious errors of diagnosis; mere congenital peculiarities, or changes incident to age, being mistaken for signs of disease.

The iris presents every shade of bluish-grey and brown among the fair and the light-brown races of mankind; whilst among the negro races it is uniformly found of a dark brown, approaching to black. A parti-coloured iris is not very rare; a fourth, a third, or even half of its surface being brown, and the rest bluish-grey: or one iris may be wholly brown, and the other as entirely grey, each eye being perfectly normal in respect of sight. Light-brown irides are often marked with two or three isolated tufts of dark pigment, and these spots are frequently causes of alarm to those who are the subjects of them.

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* This case has been already published in the *British Medical Journal*, March 20, 1869.

A very slight tremulous vibration of the whole iris attends every movement of the eyeball in some persons, who nevertheless enjoy good sight; but this tremulousness must be regarded as morbid, whenever it exists to any great extent. It is quite independent of the movements of the pupil, and is best seen when that aperture is contracted, as a larger extent of iris is then open to observation. As a decidedly morbid appearance, tremulousness of the iris is familiar to us after those cases of extraction of cataract, where much vitreous humour has been lost, or after needle-operations, where that humour has been rudely stirred up and disintegrated.

The pupil is not placed precisely in the centre of the iris, but a little nearer to the median plane of the body; so that the iris is rather narrower between the inner edge of the pupil and inner margin of the cornea than on the outer side of the pupil.

Any considerable deviation of the pupil from a circular form may be regarded as the result of disease; but the pupil may exhibit, especially in elderly persons, a slight irregularity of outline, without any disease having existed in the iris.

The mobility of the iris becomes less as age advances; and, in old people, we often find a small and almost fixed pupil, the sight remaining excellent. In examining the mobility of the pupils, each one should be tested separately, the other eye being closed; for such is the sympathy between the two organs, that when, in consequence of disease in the nervous apparatus, an eye has become quite insensible to light, its pupil, otherwise motionless, will contract whenever light is admitted to the sound eye.

The earliest mention of *iritis* occurs in a treatise by Schmidt, describing the inflammatory changes consequent upon cataract-operations as performed in his day.*

It is impossible to overrate the importance of inflammation of the iris; for when we consider that the visual function of the eye ceases, if the small aperture of the pupil becomes closed, we at once appreciate the consequences of inflammatory effusion into its area.

The attention which has been bestowed upon iritis by ophthalmic writers has led many of them to indulge in minute and tedious subdivisions of the disease, and to distinguish them by complicated terms, which only serve to embarrass and confuse the practitioner. The extent to which this evil has spread can be fully appreciated by those only who are familiar with German medical literature.*

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* *Ueber Nachstaar und Iritis nach Staaroperationen,* 1801.

This passion for subtle refinements and nomenclature has been comparatively rare with English writers; and those whose practical experience has been the most extensive have made use of the simplest classification.

Lawrence divides iritis into *acute* and *chronic*, and limits its constitutional modifications to four, the *syphilitic*, the *gouty*, the *rheumatic*, and the *scrofulous*. Tyrrell adopts the same arrangement.

There are certain signs common to all cases of iritis, under whatever constitutional modifications it may be developed; such are, a well-marked sclerotic zone; diminished mobility of the pupil, with more or less change in its form; a loss of the peculiar fibrous appearance of the iris; and a change in its colour.

Other signs mark the peculiar constitutional influence which has given rise to inflammatory action in the part. These will be noticed under the proper heads.

TRAUMATIC IRITIS.

Incised wounds of the iris are not the injuries which cause the greatest amount of inflammation in its tissue. On the contrary, clean cuts, even if very extensive, produce but little inflammatory reaction; while bruising, or continued pressure of the part, such as occurs in certain displacements of the lens, invariably gives rise to inflammation and adhesive deposits.

The wounds which are sometimes accidentally inflicted on the iris during the operation for extracting a cataract, or those which are intentionally made, to form an artificial pupil, are rarely followed by iritis; and when, after a few days, the eye is examined, more or less blood may be found at the bottom of the anterior chamber, but the fibrous tissue of the iris will present almost its ordinary aspect.

The lodgment of a foreign body, however, even of the smallest size, always sets up iritis, which does not permanently cease until the foreign body has been removed. As foreign bodies, before reaching the iris, must have passed through the cornea, I have thought it best to treat of them in Chapter IV., under the section 'Injuries of the Cornea.'

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* For remarkable instances of this mania for subdivisions and uncouth names, see the work of Von Ammon, *De Iritide*, 1836; and that of Rau, *Die Krankheiten und Bildungsfehler der Regenbogenhaut*. 1844.

A singular accident which sometimes befals the iris may be mentioned in this place, although it is really attended with very little iritis, namely, detachment of the iris from the ciliary ligament. The organic connection beween these two structures is so slight that a smart blow with a stick or a whip, the rebound of a twig, or the shock of a spent shot, is sufficient to sever them from each other; the extent of the separation varying in every possible degree, from a mere hair's-breadth to the complete detachment of the whole iris from its ciliary connection.

A very slight separation may almost escape notice. It appears as a small, black, elongated mark, close to the extreme edge of the cornea. In proportion to the extent of the separation will be the amount of deformity of the pupil; and when half of the circumference of the iris has been detached, the pupil will probably fall together and be wholly effaced.*

In all extensive cases of detachment, there is bleeding into the anterior chamber; sometimes to such an amount as at first to conceal the injury from view.

Unfortunately the surgeon can do very little in these cases. To replace the detached iris is utterly impossible, and vision must inevitably remain greatly impaired; but at least he can abstain from attempting to hasten the absorption of the effused blood by administering mercury. It may seem unnecessary to caution any one against such practice, but, in fact, the dogma that 'mercury induces absorption,' is so firmly fixed in some minds, that instances are constantly occurring of patients being actually salivated as a means of promoting the absorption of blood which is filling the anterior chamber after rupture of the iris. The rational mode of treatment is to defend the eye from strong light, and to keep the general vigour of the patient up to a healthy point, and then nature will in due time completely absorb the blood, without any aid from drugs.

I have observed how readily the iris inflames when subjected to long-continued pressure. The most striking examples of this are seen, when, in consequence of a blow upon the eye, the lens has been loosened from its connections, and partially dislocated into the pupil. The traumatic iritis is still more severe, if there be, at the same time, an incised wound of the cornea. In that case, the aqueous humour drains away, and, in consequence, the iris becomes compressed between the cornea and the displaced lens.

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* The appearances presented by separation of the iris from its ciliary attachment may be seen in most of the illustrated ophthalmic works. I may instance Mackenzie's *Treatise*, 4th edit. p. 396; Cooper, *On Wounds and Injuries of the Eye*, 1859, pp. 170, 173, 175; Lawson, *Injuries of the Eye, Orbit, and Eyelids*; 1867.

Inflammation of the iris soon sets in; vessels become visible in its tissue, and lymph is effused into the pupil, into which the lens is bulging. The cornea becomes hazy, and is traversed by vessels. The sclerotic and conjunctiva are deeply injected, and there is abundant secretion of tears. If the case be left to itself, or injudiciously treated, the pupil becomes eventually closed with effused lymph; or else the cornea softens and gives way. Meantime the deep tissues become disorganised, and, after protracted suffering, the patient finds the eye utterly useless.

The only way to anticipate all this mischief is to remove the displaced lens, which is acting like a foreign body. To do this requires much tact and care, and, in making the requisite opening in the cornea, the surgeon must endeavour to avoid isolating any considerable portion of corneal substance between his incision and the wound already existing in the cornea, lest the isolated portion should slough from interrupted nutritive supply. Sometimes the wound in the cornea is so placed that the surgeon, by enlarging it, can make an opening sufficient for his purpose. But if the wound be in the centre of the cornea, it is usually desirable to make the incision in a new portion, and as near the margin as possible. If the substance of the lens has been much broken by the original injury, the greater part of it will probably escape when pressure is applied; but if the lens be almost entire, it must be broken up as much as possible before any attempt at pressure is made. The use of the scoop will greatly facilitate the removal of the disintegrated lens, the pulpy substance escaping along the groove. In some cases the removal of a portion of iris will not only facilitate the removal of the lens with the scoop, but will prevent the occurrence or continuance of iritis.

The success of such an operation will depend upon its being performed soon after the accident, while the cornea is still clear, and before iritis and effusion of lymph have set in. If performed at a later period, there will be greater risk of vitreous humour being lost. In all cases the success of the operation, as regards restoration of sight, must be very doubtful; and if performed at a late period, relief of pain, and prevention of complete disorganisation of the globe, will probably be the best result that can be hoped for.

The treatment, after such an operation as I have just noticed, will be similar to that after an ordinary case of extraction of a cataract. Closure of both eyes for four or five days will be necessary, and the reparative powers of the patient must not be depressed by privation of due nourishment.

The surgeon must not deceive himself with the belief that in these cases of wound of cornea, with displaced lens, the administration of mercury can avert destructive inflammation. The efficacy of mercury in controlling the effusion of lymph in non-traumatic iritis, arises from the fact of there being, in that case, no foreign body—which a displaced lens really is—pressing against and irritating the iris. *Traumatic iritis*, set up by a displaced lens, is wholly beyond the powers of mercury, and its administration can only do harm, by lowering the patient's reparative power, and so unfitting him to recover from the operation, should removal of the lens be ultimately resorted to.

Rheumatic Iritis.

Rheumatic inflammation of the iris assumes either an *acute* or a *chronic* character. In the former case, the attack can usually be traced to exposure to cold wind or damp, when the body has been exhausted by fatigue or greatly overheated.

According to the nervous susceptibility of the patient, the onset of an attack of rheumatic iritis will be attended either by dull pain in and around the eyeball, or by acute neuralgia throughout the first division of the fifth nerve, extending even to the second and third divisions.

When the attack is severe, there is usually a good deal of intolerance of light, and lacrymation. The vascular zone is not well-marked, on account of its being lost in the general injection of the whole sclerotic, which assumes the purplish tint I have described as characterising sclerotic inflammation.

Rheumatic iritis is almost always attended with some slight haziness of the cornea, and in this respect it differs remarkably from the syphilitic form, which, even in the most severe cases, often leaves the cornea perfectly clear. The morbid changes in the iris itself are sometimes so slightly marked as to escape an unpractised or a careless observer; so that it is not until the inflammation has subsided, and the cornea has become quite clear, that the still-existing impairment of sight causes a more careful scrutiny of the pupil to be made, and then inflammatory exudation into its area, and adhesion of its margin, are found to have taken place.

In the more acute form of rheumatic inflammation, the veins of the iris may be traced on various parts of its surface, as delicate red lines, diverging from the edge of the pupil to the periphery of the iris. I need hardly say that these fine vessels cannot be traced if there exists any considerable haziness of the cornea.

The pupil is contracted, more or less irregular, and as the inflammation goes on, this irregularity becomes more marked, in consequence of effusion of lymph* taking place between the edge of the pupil and the capsule of the lens. The insidious manner in which this fibrinous effusion occurs affords a marked contrast to the rapidity with which large masses of yellow or reddish-yellow lymph show themselves on the edge of the pupil in syphilitic iritis.

I have already noticed the neuralgia throughout the region supplied by the ophthalmic division of the fifth nerve, which attends an acute attack of rheumatic iritis. There is also very frequently considerable febrile disturbance, the urine being loaded with lithates.

The majority of cases do not present such acute symptoms as those just described, but pursue a more chronic course. The injection of the sclerotic being less general, the vascular zone around the cornea is better marked; there is little, if any, intolerance of light or lacrymation, and instead of severe neuralgia in the fifth nerve, there is only a dull aching pain in and around the eyeball.

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* In describing iritis, I shall frequently have occasion to speak of that exudation from its vessels which constitutes the most serious feature of the disease, by forming adhesions between the pupillary margin and the capsule of the lens, or wholly blocking up the area of the pupil with opaque membrane. Whether this *exudatum* becomes itself converted into fibrous tissue, or whether it only influences the cells of the tissue among which it is effused, and causes new cells to be developed from those already existing, is a physiological question which can hardly be decided. I have used the term 'lymph' to describe this *exudatum*, because the word is familiar to all my readers, and is sanctioned by long usage.

But, whether the iritis be acute or chronic, there is still the same danger of effusion of lymph into the area of the pupil, and this danger is, as I have said, all the greater on account of the gradual and insidious manner in which the effusion takes place. To check this is the main object to be kept in view.

Treatment.—If the early stage of acute rheumatic iritis be attended with severe neuralgia, as is frequently the case, the treatment will be much the same as that which I have described in Chapter V., as suitable to acute inflammation of the sclerotic. In some patients iodide of potassium, in others colchicum, will be of most service; while some cases, characterised by visible enlargement of the veins of the iris, yield to turpentine. I have usually given the Chian turpentine in substance, as pills, four grains three times a day. The condition of the pupil must be carefully scrutinised from day to day; and if it be found irregular and angular, or if any brownish tags appear to be forming at its edge, mercury must at once be given. Two grains of calomel, with a third or half a grain of opium, may be taken night and morning; and should any tenderness of the gums begin, the quantity ought at once to be diminished; for if salivation be allowed to occur, the neuralgia is almost certain to return, and the mercury, which in small doses was so beneficial, begins at once to exert its depressing influence. In delicate subjects it is often very useful to give a dose of bark—Battley's liquor cinchonæ or quinine—in the middle of the day, during the time the mercury is being taken. During the inflammatory stage the pupil is to be kept under the action of atropine.

It is almost impossible to lay down precise rules about diet. It should not be *low*—that is to say, innutritious—but light and easily digestible: soup, bread-and-milk, farinaceous food of various kinds, with or without a proportion of meat, according to the patient's digestive powers and previous habits. Stimulants should be given only in such quantities as may be necessary to sustain the circulating forces. Feeble and depressible persons may require a certain amount of dry wine, or diluted spirit, while those addicted to habitual indulgence may only eliminate the rheumatic poison which they have stored up in their blood, by abstinence from the alcohol and sugar they have so long abused.

Occasional steaming of the eye over hot water is the most soothing local application, and where neuralgia is present, is preferable to fomentation by means of wetted compresses.

Leeches to the temples may occasionally be found useful at the onset of an acute attack; but where neuralgia exists they commonly do harm, and they should never be applied to feeble and depressible subjects, or those liable to erysipelas. Blisters also have the disadvantage of exasperating neuralgia. They are, however, very serviceable in the chronic form which often succeeds the acute attack, and they certainly aid in removing that haziness of the cornea, which, if not promptly dispersed, is apt to become permanent.

Syphilitic Iritis.

Inflammation of the iris originating in syphilis is very frequently associated with other forms of secondary or tertiary disease, especially with eruptions on the skin. It is by far the most marked kind of iritis, and is characterised by a tendency to rapid and abundant inflammatory exudation on the iris, especially about the edge of the pupil, in which situation yellow, reddish-yellow, or nearly red nodules sometimes attain to such a size as almost to close up the pupillary area.*

The cornea is either clear, or marked throughout its lower half by very minute dots, of a pale buff tint. These dots are as small as if pricked in with the point of a pin, and are so closely set together as to suggest to a superficial observer the idea of a faint cloudy haze. It often happens, however, that even these minute dots are wholly absent, and the cornea, during an acute attack of iritis, remains perfectly transparent.

There is always a vascular zone in the sclerotic, but not that generally diffused redness of the eyeball so frequently present in rheumatic iritis. Neither, as a rule, is there intolerance of light, which is one of the most marked symptoms of the rheumatic form.

Irides which have naturally a bluish tint, when attacked with syphilitic inflammation, appear more or less green. This is caused by the presence of yellow albumen in the aqueous humour, the admixture of the yellow and blue forming, of course, a green tint. This fact may be demonstrated in some of those old cases in which chronic iritis has attacked an eye again and again, until sight has been lost, nearly all the tissues having undergone a morbid change. If in such a case the cornea be carefully punctured with a broad needle, and the fluid of the anterior chamber caught in a spoon, the application of heat will at once show the presence of albumen; and if the iris have been originally bluish, that colour will be restored as soon as the last drop of the yellow fluid has drained away from the anterior chamber.

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* In Sichel's *Iconographie* (pl. xiii fig. 5), is a good representation of a mass of lymph, reddened with vessels, at the edge of the pupil.

When a patient has syphilitic iritis for the first time, it may attack both eyes together, or may be limited to one eye. When relapses occur, the inflammation usually affects the right and left eye alternately; and these attacks may come on without the patient having contracted any fresh primary disease.

Syphilitic iritis is so much modified by the condition of the patient, that the surgeon must take care not to form to himself any arbitrary idea of the appearances, or expect to find in every case the strongly-marked and unmistakable proofs afforded by large nodules of exudation around the pupil. In fact, iritis may exist to such an extent as to produce serious and permanent obstruction to the pupil, without any development of these nodules. In some cases the lymph is uniformly distributed around the margin of the pupil, which then assumes a thickened ring-like appearance, the rest of the iris exhibiting little, if any, deviation from its healthy aspect. The loss of its mobility, however, is always well marked, even in the slighter cases; and, indeed, the sluggishness or total immobility of the pupil, when exposed to light, is one of the most valuable diagnostic signs of iritis in its early stage.*

Occasionally the nodules of lymph, instead of appearing on the edge of the pupil, are situated on the greater circle of the iris, in the re-entering angle formed between it and the cornea. Such cases are comparatively rare.

In every case of iritis, the surgeon should most carefully examine the area of the pupil, to determine whether it be or be not overspread with lymph. This sometimes exists merely as a very thin film, which may escape detection, unless light be concentrated upon it by means of a lens of short focus. Such a film, however, if not speedily removed by proper treatment, will rapidly become thickened by fresh deposits, and, growing more and more opaque week by week, will eventually form a serious obstacle to the transmission of light.

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* I cannot point out any really good representation of iritis in its early stage. Indeed, it is hardly possible for an artist to convey a true notion of the delicate changes in form and colour which characterise the disease at that period.

The so-called 'closure of the pupil,' justly regarded as the most serious termination of unchecked iritis, is caused partly by the nodules of lymph which are thrown out upon the margin of the pupil, and unite it to the capsule of the lens (*synechia posterior*), and partly by fluid exudation of the same inflammatory kind, which overspreads that portion of the capsule corresponding to the pupillary area. This exuded fluid, as it solidifies, forms organised connections with the nodular deposits on the edge of the pupil, and eventually, by its contraction, draws the margin of the pupil together, and permanently blocks up its greatly diminished space with a tough, firm, and opaque membrane.*

Treatment.—From what has been said, it will be seen that the leading principle in the treatment of syphilitic iritis consists in procuring as quickly as possible the absorption of the lymph which has been effused in and around the pupil. To effect this, the most powerful agent is *mercury*. But when we consider the variety of constitution in patients attacked with syphilitic iritis, the impaired state of general health they frequently exhibit, in consequence of venereal taint, and the period at which the iritis sometimes occurs—namely, while they are only just recovering from the debilitating effects of salivation—it is evident that, in a treatise like the present, little more can be done than to indicate the outlines of treatment, and that the judgment and tact of the surgeon must be brought to the careful study of each individual case.

When a recent case of syphilitic iritis comes before us in a patient of good general power, we may at once order two grains of calomel, with a third or half a grain of opium, to be taken night and morning; first clearing the bowels, if necessary, by a rapidly-acting aperient. In private practice, where our patients are not necessarily exposed to the weather, the calomel may be given more frequently, but in smaller doses; a grain, for instance, every four hours, combined with just enough opium to prevent purging.

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* This form of obstruction is sometimes called 'spurious cataract;' but the term is manifestly improper, as the word 'cataract' should be strictly limited to opacity of the lens itself.

The effect of the mercury must be judged of by the state of the eye, not by the soreness of the gums. Indeed, I look upon soreness of the mouth as a condition to be always avoided, if possible; never to be willingly produced, as is so often the case. As soon, therefore, as the gums begin to be at all affected, the calomel is to be given less frequently; the absorption of the lymph in the pupil being the test of the mercury having been effectual. The two-grain pills may be taken once instead of twice a day; the grain every four hours changed to the same quantity every twelve hours, and then taken at twice that interval of time.

A patient sometimes comes before us with recent iritis, which has come on while he was actually under the influence of mercury, given for venereal disease. What are we to do in such a case? Perhaps we shall find that the patient, while taking the mercury, has been kept on very low diet, deprived of all animal food, and restricted to 'slops.' In that case, the mere change to a better diet—animal food and other nutriment being given, with a moderate quantity of the stimulant to which he has been accustomed—will often effect a surprising change, and stop the further effusion of lymph; while iodide of potassium, with bark, or, if the patient be extremely depressed by the mercury, even quinine alone, will at once cause absorption of the lymph to begin.

Or a directly opposite state of things may exist. The patient may have sought relief from the depressing effects of too much mercury by indulging in stimulants, and in this way may have induced an irritable condition of the circulation, quite incompatible with a due interchange of material in the system. Restriction of stimulants within due bounds will be as essential in this case as their use had been in the case of the ill-nourished and anæmic patient.

If a patient has been attacked with syphilitic iritis while under the depressing influence of too much mercury, given for general syphilis, and it has been found necessary to suspend the use of the mercury until tonics and a change of diet should have improved his general health, we shall often find, that by resuming the mercury in *small* doses, while at the same time we continue the tonics, the iritis will yield, although it may have resisted the large doses which had been given under circumstances of over-stimulation or deficient nutrition.

Turpentine was recommended by Carmichael, as a substitute for mercury, in those cases to which I have alluded as unsuitable for the administration of the latter, on account of general debility. I have, however, found more benefit from the use of iodide of potassium, or even of very small doses of mercury, combined with tonics and improved diet, as above described. I have sometimes found turpentine of service in cases of rheumatic iritis, characterised by hyperæmia of the iris and sclerotic, but unattended with much disposition to effusion of lymph.

Whether the iritis be treated with mercury or not, the pupil is to be kept dilated by means of atropine.

Syphilitic iritis has often a tendency to become *chronic*; each relapse being characterised by a slight sclerotic zone, a yellowness of the aqueous fluid, giving a greenish tint to blue irides, general dimness of sight, and a slight filmy deposit in the area of the pupil. This chronic form is chiefly found in patients who are the subjects of tertiary syphilis, and a carefully-regulated course of iron often affords the best means of treatment.

In describing iritis, I have hitherto spoken only of those changes which are visible under ordinary observation; but the ophthalmoscope has demonstrated to us, what we formerly could only guess at, namely, that in so-called iritis the *retina* is often more seriously affected than even the iris itself.

To attempt to examine the retina during an acute attack of iritis, would be not only useless, but injurious; for the lymph deposited in the pupil, and perhaps in the vitreous humour also, would prevent any clear view of the parts behind; while the glare of light would be almost certain to increase the already existing hyperæmia of the organ. We often, however, have the opportunity of examining the retina after all inflammation has passed away, leaving the cornea, lens, and vitreous humour transparent. We can then fully appreciate the close connection between syphilitic inflammation of the iris and of the retina, and understand why it is, that in cases of so-called 'iritis,' the dimness of vision is often out of all proportion to the changes in and about the iris.

One of the sequelæ of iritis (I use the word 'iritis' in its more extended sense), is a cloudy condition of the vitreous humour, in which filaments and shreds, varying in shape and size, float freely in every direction. These bodies, although really whitish, of course appear black, or nearly so, when seen against the illuminated retina. They appear to be inflammatory deposits, intermixed in some instances with broken-up hyaloid membrane.

The retina presents still more varied marks of syphilitic inflammation. The optic nerve appears greatly enlarged, irregular in its outline, and of a homogeneous whitish texture. It is probable that in such cases we do not see the real tissue of the optic nerve, but only a layer of lymph overlying it. The vessels emerging from the nerve are small and shrunken. Large, irregular, white patches are scattered over the retina, in some cases involving the greater part of its surface. These appear to be portions of the nervous coat infiltrated with lymph, and no longer permeated by vessels. Patches and dots of black pigment are frequently seen scattered over and among these opaque portions of the retina. (Plate II. fig. 1.)

Hence, it appears that syphilitic inflammation, when it attacks the eye, may exhibit its chief phenomena in the iris, involving the retina only to a very slight extent; or both structures may be equally affected; or lastly, the retina may suffer in such a degree as almost to become useless, while the iris shows little, if any, sign of inflammation, and the patient is hardly aware of the eye being the subject of disease, until vision is found to be almost lost.

Syphilitic Iritis in Infants.

Iritis is one of the rarest forms in which hereditary syphilis manifests itself during infancy. The careful researches of Mr. Hutchinson,* however, have shown that it is not quite so rare as has been supposed; and it probably often escapes notice on account, as he observes, of the very small amount of local symptoms which it causes, coupled with the fact that infants usually keep their eyes shut. Within the last ten years I have seen but five or six cases of syphilitic iritis in infants, among the many thousands of patients whom I have treated at the Moorfields Hospital. Some of these infants presented the stunted and unhealthy aspect which usually accompanies inherited syphilis; but two, whose cases I have elsewhere reported in full,† were well-grown children.

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* The result of Mr. Hutchinson's observations is given in *A Clinical Memoir on certain Diseases of the Eye and Ear, consequent on Inherited Syphilis*, &c. 1863.

† *A Guide to the Practical Study of Diseases of the Eye*, 2nd edit. 1859, p. 149.

One of the most striking peculiarities of iritis in infants is the very slight development of a sclerotic zone, that unfailing sign of iritis in the adult. Indeed, in some of the cases I have seen, sclerotic redness could hardly be said to exist.

The infant at the age of from two to ten months is attacked with copper-coloured eruption; perhaps also with mucous tubercles about the genitals, aphthæ in the mouth, and 'snuffles.' The eyelashes fall off, and sometimes the nails also are partially detached. In some cases the skin presents a peculiar dusky tint, and is wrinkled and scurfy.

The lymph does not assume the form of solid tubercular masses on the edge of the pupil, as in the adult, but either fills the area of the pupil, as a pale yellow semi-fluid mass, or sinks down to the bottom of the anterior chamber, like ordinary *hypopyon*. In one of the cases I saw, the lower half of the iris was completely hidden by a nodular mass of lymph, of a pale buff tint, which came into contact with the cornea, and completely filled the anterior chamber as high up as the middle of the pupil.* In another case, the effused lymph—for such it seemed to be—was scattered all over the lower half of the iris in the form of little, greyish-white, semi-transparent granules, like grains of coarse sand. The pupil was fringed with the same kind of deposit.

Treatment.—Before speaking of any special medicines for infants affected with syphilitic iritis, I would remark on the absolute necessity for their being suckled, and not brought up by hand. The milk of a healthy wet-nurse would of course be infinitely preferable to that of an infected mother; but in the lower classes of society, among whom this disease is almost exclusively met with, the services of a wet-nurse can hardly be obtained.

Mercury should at once be given; and as hydr. c. cretâ is very uncertain in its chemical composition, I always make use of calomel, giving from a quarter of a grain to half a grain night and morning. The effect of the medicine must be carefully watched from day to day, and as soon as the lymph begins to disappear from the eye, and the cutaneous eruption to fade, the dose may be gradually diminished; but it will often be necessary for the mercurial treatment to be continued, in a modified form, for several weeks. Weakly infants will be much benefited by taking five minims of Battley's liquor cinchonæ twice a-day in a little milk. Provided the child sucks and digests well, the mercury does unmixed good, and, by counteracting the venereal poison, not only frees the skin from the specific eruption, but imparts to it a healthy hue, instead of the peculiar dusky colour which was originally so evident.

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* *Guide to the Practical Study of Diseases of the Eye*, 2nd edit. 1859, p. 149, fig. *a*.

A few drops of a solution of atropine containing two grains of the sulphate to an ounce of water, may be put into the eye once a day. So powerful a poison cannot safely be used without limit to young infants, even in its diluted form.

Scrofulous Iritis.

Most of the patients in whom I have observed this form of iritis have been between five and fifteen years of age, and all have shown signs of a scrofulous constitution.

The iritis presented a resemblance to the syphilitic inflammation of adults, in respect of the abundant exudation which took place on the iris, and in the anterior chamber; but in the severer cases of the scrofulous form there was a still greater disposition to enlargement of the veins of the iris, and infiltration of its whole tissue, than is usually met with in syphilitic cases. In scrofulous iritis the large masses of yellow deposit are not so frequently limited to the margin of the pupil, but often appear midway between the pupil and the outer circle of the iris, or at the latter point, just in the angle between the iris and the cornea. Slight bleeding not unfrequently takes place into the anterior chamber, from giving way of the distended veins of the iris.

The cornea usually remains clear, but it sometimes presents a slight degree of mottled opacity, especially towards the lower part.

Treatment.—In the treatment of scrofulous iritis, as in all scrofulous affections, the diet and general mode of life deserve the utmost attention. Abundance—not excess—of animal food; warm clothing; pure air—sea-air, if attainable—are all important adjuncts to the medical treatment. Cod-liver oil is often of great service, and may be taken in combination with the other remedies. The bowels are usually irregular, and the appetite bad; and a mild aperient will be occasionally required; but care should be taken to avoid drastic purgatives, such as scammony and jalap.

When there is abundant inflammatory exudation into the anterior chamber, without much enlargement of the veins of the iris, or development of a sclerotic zone, half a grain or a grain of calomel at night, and two or three grains of quinine, or ten or twelve minims of liquor cinchonæ, taken an hour or so after a meal, will often produce a rapid absorption of the effused fluid. Where the exudation assumes the solid form, infiltrating a considerable portion of the iris, or appearing at its inner or outer circle as large yellow nodules, reddened with vessels, the iodide of iron is often useful, both in promoting the absorption of the deposit, and in diminishing the vascularity of the iris itself.

All stimulating lotions must be avoided; nor, indeed, except atropine, is any local application of service.

Gonorrhœal and Arthritic Iritis.

I have never been able to trace an attack of iritis as a result of simple gonorrhœa; although, of course, it may often happen that a patient is attacked with ordinary rheumatic iritis within a short period of his having had urethral discharge. Gonorrhœa is unfortunately so common, that were there any definite form of iritis dependent upon it, so marked a sequela of the discharge would be constantly brought under our notice.

Neither have I seen cases of iritis which I could refer to gout. The descriptions of ‘arthritic iritis’ one meets with in books are chiefly taken from German writers, especially Beer and his contemporaries, whose account of the disease, which they term *gouty* inflammation, more nearly answers to that of chronic glaucoma. The ash-coloured ring in the sclerotic, immediately surrounding the cornea, described by German writers as the *arthritic* ring or circle, and regarded by them as diagnostic of arthritic iritis, is not peculiar to any special form of inflammation. Its presence merely depends upon the anatomical arrangement of the adjacent portions of the sclerotic and cornea. When these two structures are united obliquely, so that a considerable extent of the sclerotic is overlapped by the cornea, the vessels of the former do not appear to advance so near to the iris as in other cases; and hence a narrow ring, of a paler tint, is interposed between the iris and the dense plexus of vessels forming the sclerotic zone.

USE OF ATROPINE IN IRITIS.

In a former edition of this work I spoke unfavourably of the employment of atropine during the acute stage of iritis. Subsequent experience has led me to modify my opinion on this subject. Of course the action of atropine will be most evident in those cases where the inflammation is quite recent, and where consequently the tissue of the iris is not, as yet, much thickened by congestion of its vessels, nor infiltrated with lymph. Where abundant effusion of the latter has taken place around the margin, and within the area of the pupil, atropine may not produce any change visible to the observer; but when this stage of effusion has not yet arrived, or when, at a later period, it is passing off, persistent dilatation of the pupil may be induced by atropine, and such dilatation will have the effect of hindering the formation of adhesions between the iris and the capsule, or of causing such adhesions, if already existing, to give way. In all cases of iritis, therefore, a solution of atropine should be dropped upon the eye night and morning. Where the inflammation is recent, and atropine is used in anticipation of lymphatic effusion, rather than to counteract the solidification of deposits already formed, a solution of two grains of the sulphate of atropia in an ounce of distilled water, may be employed; but in the more acute cases a solution of double that strength will be required.

Not contented with insisting on the utility of atropine as an adjunct to mercury in the treatment of iritis, some recent writers have even gone so far as to recommend that the disease should be treated by the use of atropine alone. More dangerous trifling I cannot conceive. No doubt cases of iritis occur in which the tendency to effusion of lymph can hardly be said to exist at all, and such exceptional cases may possibly get well without any mercury being given. But we are not warranted in assuming that a case of iritis which begins in a mild form is going to maintain that character throughout, and it is our duty to employ that agent which above all others has the property of counteracting the effusion of lymph, and the consequent loss of transparency in parts essential to vision. And what rational cause is there for this anxiety to avoid the employment of mercury? Used ignorantly, as we too often see it used, mercury is a fearful curse to mankind; but moderately and judiciously used it is one of our greatest blessings. If patients with iritis are to be so impregnated with mercury that profuse salivation and all the other miseries of mercurial poisoning are induced, they may well pause before submitting to a remedy almost as bad as their disease. But this kind of mercurial treatment is never necessary. Those cases of iritis commonly do best where the mouth has not even been made tender, and therefore there is no real necessity for the attempts that are being constantly made to treat iritis without mercury. We are often told that iritis will get well without it—and so no doubt it will, in a certain sense, get well without any treatment at all. But what is meant by 'getting well?' A wound gets well when a sufficient deposit of organisable material has taken place between the divided surfaces; and the denser the cicatrix, the more thorough is the cure. Or a case of hydrocele 'gets well' when the walls of the sac are thoroughly glued together by abundant inflammatory deposit. But the eye is in one respect a wholly exceptional organ. Once let its transparent tissues become opaque, and then, although the eye may in a certain sense have recovered from an inflammatory attack, the function of the organ is impaired or destroyed. The treatment of iritis consists in speedily preventing the formation of patches or films of inflammatory deposit in the transparent media of the eye, and if mercury has the invaluable property of doing this, it seems criminal in the surgeon to neglect the use of it.*

It is a curious fact that in certain persons the application of sulphate of atropia to the conjunctiva will set up all the symptoms of acute catarrhal ophthalmia. I do not speak of solutions to which a few drops of acid or of alcohol have been added. Such additions, I know, are sometimes made; but they are as unnecessary as they are irritating, for well-made sulphate of atropia is quite soluble in distilled water. The first instance of my meeting with this effect of atropine occurred several years ago, in a hospital in-patient who used drops from the same solution that was being dispensed at the time to many hundreds of others, none of whom experienced any similar inconvenience. As soon as the drops were discontinued, the conjunctival inflammation rapidly subsided, and it was again excited by a reapplication of the atropine. I have recently met with another case, in which great irritation, both of the eye and eyelids, followed the use of drops which I myself applied and knew to be perfectly neutral.

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* Remarks on the use of atropine in iritis almost identical with the above, were to have been added to the third edition of my *Guide to the Study of Diseases of the Eye*, 1866, but by inadvertence they were not sent to the printer.

Sequelæ of Iritis.

Besides the changes already mentioned as resulting from iritis, such as obstruction, or closure of the pupil, the inflammation is sometimes followed by degeneration of structure, which more or less involves the whole tissue of the iris.

Chronic iritis, for instance, in a cachectic subject, especially if the disease has been allowed to run on unchecked, is apt to induce a permanent thickening of the iris, all appearance of its normal fibrous tissue being lost, and the veins of the part becoming enlarged and irregularly dilated.

On the other hand, the constant pressure of a calcified lens, which has become thrust forward against the iris, will sometimes induce such wasting of its tissue, that the uvea wholly disappears, and the thin web of iris which remains allows the chalky-white lens to be distinctly seen through it.

Another consequence of iritis is the distension of the iris into *pouches*, which are formed in the following way. An attack of syphilitic iritis, left to itself, or badly treated, causes the whole margin of the iris to adhere to the capsule of the lens; the pupillary area being, at the same time, very small, and filled up with opaque deposit. All communication between the anterior and the posterior aqueous chamber is cut off; and the aqueous fluid secreted in the latter cavity, not being able to pass through the pupil into the anterior chamber, accumulates behind the iris, and gradually distends and presses it forwards; the pupillary margin meantime being prevented from advancing with the rest of the iris in consequence of its union with the capsule.

If the uveal surface, except just at the edge of the pupil, be free from adhesion, the whole anterior surface of the iris forms one convex mass, with a deep depression at its centre, in the position of the closed pupil; but if the uvea be here and there adherent to the capsule of the lens, the iris at those spots remains retracted, like the pupil, while intervening portions of iris are thrown into a series of pouches which may almost, or quite, touch the cornea. These pouched portions of iris lose their fibrous appearance, and have a dark slaty tint.

Vision, in such cases, is reduced to mere perception of light; but, provided the retina be sound, excellent sight can often be restored by means of a carefully-planned and skilfully-executed artificial pupil.

In cases of long-continued iritis, combined with disease of the choroid, and of the anterior portion of the sclerotic, the iris not only becomes united to the capsule, and bulges forwards in the manner just described, but the fluid secreted in the posterior aqueous chamber, continuing to accumulate, exerts pressure on the anterior portion of the sclerotic, and stretches its weakened tissue. This gradually yields, and forms a *staphyloma scleroticæ*, a tense bluish-black prominence, streaked with the widely-separated whitish lines of the sclerotic fibres. At first, while the prominence is small, it is usually situated at the upper part of the globe, just behind the cornea; but the distension may go on until the whole of the sclerotic, between the line of insertion of the recti muscles and the margin of the cornea, forms one bulging lead-coloured swelling. *Staphyloma scleroticæ* is always a sign of the deeper tissues of the eye having suffered from disease, and, if developed to any considerable extent, would contra-indicate operations for artificial pupil or cataract.

Cysts of the iris.—In very rare cases a punctured wound of the iris, near its ciliary attachment, has been followed by a cyst-like expansion of its substance, in consequence, apparently, of the fluid of the posterior aqueous chamber finding its way between the uvea and the fibrous tissue of the iris.

These cysts present a dark slaty tint, which nearly approaches to black when their walls become very thin. The treatment of these cases is often extremely troublesome, on account of the readiness with which the expanded iris-tissue reunites after being lacerated. When the lens is *in situ*, and transparent, the difficulty is greatly increased.*

OPERATIONS ON THE IRIS FOR ARTIFICIAL PUPIL.

Many of the diseases and injuries affecting the iris and cornea described in the foregoing chapters, produce complete closure of the pupil, while others either cause it to become displaced from its natural position, or leave it more or less completely hidden behind a dense corneal opacity.

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* See a case reported at length in my *Guide to the Study of Diseases of the Eye*, 2nd edit. 1859, p. 408.

All operations for the relief of such obstructions or mal-positions of the pupil may be suitably described in this place; while the operation on the iris, for the cure of *glaucoma*, must be deferred until that disease has been considered.

The term *Artificial Pupil* must be understood to include not only the formation of a new aperture in the iris, when the portion forming the natural pupil has prolapsed through a breach in the cornea, but also the reopening or the enlargement of the natural pupil when obstructed by inflammatory deposit; or the displacement, towards a transparent part of the cornea, of a pupil which has become overshadowed and hidden behind a dense corneal opacity.

Before attempting any form of operation for artificial pupil, the surgeon must make himself thoroughly acquainted with the history of the case, and especially ascertain for himself the following conditions:

First, whether the eye perceives light: mere obliteration of pupil will not deprive the eye of this power, provided the retina be sound; for we know, by personal experiment, that even the thickness of our closed lids does not prevent our noticing the shadow of a hand passing between our eye and the window.

Secondly, the presence or absence of the lens must, as far as possible, be ascertained, and, if present, whether it is transparent or opaque.

Thirdly, the cornea must be carefully examined, as to its degree of transparency.

Fourthly, the state of the iris itself must be noticed. The existence of chronic iritis would induce the surgeon to defer the operation until the inflammation had ceased. A thickened iris, in which all trace of its peculiar fibrous structure is lost, is specially unfitted for an operation, as it breaks away under the slightest traction, and, if cut, the wound does not gape, so as to form a permanent aperture.

As a rule, it is not desirable to operate for artificial pupil when the other eye is perfect.

The principle, not to inflict unnecessary injury on the parts operated upon, which holds good of every surgical operation, applies with peculiar force to that for an artificial pupil; for often the portion of transparent cornea is very small, and a needlessly large cicatrix may seriously diminish the patient's field of vision.

Generally speaking, a small artificial pupil is more useful than a large one; that is to say, if it can be made in such a position that all the cornea in front of it is transparent. Sometimes, however, the pupil has to be drawn from behind an opaque corneal cicatrix; and in that case it is only by making a large aperture that a sufficient portion of it can be rendered available.

Inasmuch as the natural pupil is placed nearly in the centre of the iris, it would follow that a similar position must be the most suitable for an artificial aperture. Various considerations, however, may induce the surgeon to select a more peripheral situation; but he should always strive to approach the centre of the iris, as far as circumstances will allow.

Peculiar care is required in the examination of those cases, frequently brought under our notice, in which the greater part of the cornea appears converted into a more or less prominent, densely opaque, white cicatrix, after severe purulent or gonorrhœal ophthalmia. The patient may have good perception of light, and there may be an appearance of a narrow strip of semi-transparent cornea adjacent to the sclerotic, suggesting the possibility of an artificial pupil being made. And yet the appearance of true corneal tissue may be altogether deceptive.

When the whole cornea has been destroyed by ulceration, as in severe purulent ophthalmia of infants, or the gonorrhœal ophthalmia of adults, the iris is for a time laid bare; but very soon exudation takes place on its surface, while the iris, yielding to the pressure behind, gradually forms the prominence known as *staphyloma*. The greater part of this fibrinous coating of the iris eventually becomes white and opaque, and traversed by ramifying vessels; but the marginal portion of the iris is covered by a semi-transparent tissue, united, perhaps, to a very narrow ring of true cornea, just that portion immediately connected with the sclerotic. No space, however, exists between this semi-transparent, cornea-like tissue, and the fibres of the iris; and any attempt, therefore, to make an artificial pupil in this situation would only end in disappointment.

The different modes of making an artificial pupil may be classed under four heads: *laceration, incision, excision,* and *ligature.*

1. *Laceration.*—This consists in tearing away a certain portion of the iris from its ciliary attachment, and is so unscientific, clumsy, and ineffectual an operation, that I should not even mention it, were it not sanctioned and recommended by many continental authorities in ophthalmic surgery. Near the margin of the cornea an incision is made, through which a sharp hook is introduced, and then carried across to the opposite side of the anterior chamber. Here the hook is stuck into the iris, and then drawn back towards the corneal wound. This traction causes the ciliary attachment of the iris to give way; and when the iris has been separated to the extent desired, the hook is detached and withdrawn from the eye.

An artificial pupil of this kind involves almost all the faults it is possible to include in one operation. Its position, opposite to the margin of the cornea, is the worst that could possibly be chosen; the size of the rent cannot be accurately limited; the vessels and nerves of the iris are torn just where they are largest; the great circular vein, surrounding the iris, pours out a quantity of blood, which partly or wholly fills the anterior chamber, and is not readily absorbed; if the lens be present, there is considerable risk of wounding it with the hook, which, in its withdrawal, is frequently caught in the corneal incision. It is to be hoped that this operation, if not already obsolete, will speedily be consigned to the limbo of exploded surgery.

2. *Incision.*—This is the oldest form of operation for artificial pupil, being that employed by Cheselden in a case commonly spoken of as the first in which an artificial pupil was made. The operation is founded on the elasticity of the fibres of the iris, which causes them to retract when cut across, so as to leave an aperture for the transmission of light to the retina. Hence it will be seen that the operation is likely to succeed in proportion to the state of tension and retractile power of the iris, and will be inadmissible in those cases of closure of the pupil resulting from chronic iritis, or any other disease of the iris which has caused softening and degeneration of its tissue. The operation by incision would also be contra-indicated if the lens were present, as injury to it must almost inevitably follow the penetration of the iris by a cutting instrument.

The operation, therefore, is much restricted in its application, and is almost confined to those cases in which, after extraction of a cataract, there has been prolapsus iridis to such an extent as wholly to obliterate the pupil, the fibres of the iris remaining on the stretch in consequence of so large a portion becoming healed into, and confounded with, the corneal cicatrix.

The incision is made either with a cutting-needle or a fine narrow knife, or else with scissors. The needle or knife is passed into the anterior chamber close to the edge of the cornea, and when the point has been carried a little beyond the middle of the iris, the cutting edge is turned backwards, the point is made to penetrate the iris, and its fibres are divided to such an extent as may be desired. The needle or knife is then rotated into its original position and withdrawn.

Maunoir * modified the operation by using scissors for dividing the iris; but of course they required a large corneal wound for their introduction, and neither the linear nor the V-shaped incision which he recommended was found by any means easy to accomplish when the iris had become flaccid after the escape of all the aqueous humour. If scissors are employed at all, the cannula-scissors, invented by Wilde, would be found far more convenient for incising the iris, as they may be so constructed as to cut their own way into the cornea, and fill up the wound they make, thus retaining a good deal of the aqueous humour.

In cases where a very narrow strip of cornea alone remains transparent, after sloughing or ulceration throughout the rest of its extent, it becomes of the utmost importance to accomplish the division of the iris with as little injury to the cornea as possible. In such cases I have found the most useful instrument to be a broad needle, cutting on both sides for a short distance from its point.

3. *Excision.*—In cases where the pupil had become drawn together, and its contracted area blocked up with an opaque membrane, in consequence of iritis, the lens being unaffected, the operation of incision, either by the knife or scissors, was contra-indicated, since it was hardly possible to puncture the iris with a cutting instrument without wounding the lens. The operation of excision therefore became necessary, which was performed as follows: an opening of sufficient size having been made in the cornea, a forceps was introduced into the anterior chamber; its branches were then opened, a portion of iris was included between them, and, being grasped, was drawn out of the corneal wound, and cut off with scissors. The objection to

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* *Mémoires sur l'Organisation de l'Iris et l'Opération de la Pupille artificielle,* Paris, 1812.

this operation was the difficulty of limiting the quantity of iris removed; the pupil was usually very large, and extended almost, if not quite, up to the border of the cornea.

The 'blunt hook,' invented by Tyrrell, introduced a more delicate and precise mode of operating; and, for special cases, has not been superseded by any subsequent contrivance. It requires only a very small corneal wound for its introduction; and it can be employed without risk in cases where the lens is *in situ* and transparent.

It is specially adapted for the following cases. First, when, after extraction, there has been extensive prolapse of the iris, so as to obliterate all but a very small vestige of the pupil. Secondly, when, in consequence of iritis, the whole pupillary margin has become adherent to the capsule, the peripheral portion of the lens itself remaining transparent. And, lastly, when the iris is perfectly healthy, but the pupil is hidden behind a dense central opacity of the cornea, the rest of the cornea remaining clear.

a. In a case such as I have alluded to under the first head, we will assume the lens to have been extracted through an upward section of the cornea. The artificial enlargement of the pupil would be made in the following manner: the lids being held apart with a spring-wire speculum, the surgeon steadies the globe by nipping up with a forceps a little fold of the ocular conjunctiva, just above the upper edge of the cornea; he holds in the other hand the broad cutting-needle, which he passes through the lower edge of the cornea, close to its junction with the sclerotic. If the width of the blade be properly proportioned to the size of the hook, a simple puncture will suffice; but if the needle be narrow, its edges may be used to enlarge the wound to a sufficient extent. The needle should now be gently withdrawn; not with a jerk, as such a movement is usually followed by a spurt of aqueous humour, and it is important to retain as much of that fluid as possible. The surgeon then takes the blunt hook, and passes it in through the corneal wound, the flat side of the hook coming in contact with the iris. The instrument, held in this position, is rapidly passed upwards, until its extremity reaches the small pupillary opening; then the handle is rotated so as to allow of the lower edge of the displaced pupil being firmly caught in the bend of the hook; gentle traction is then made, and at the same time the handle is again rotated in such a manner that the short bent portion faces directly forwards. It is only in this position that the hook can be withdrawn through the corneal wound without catching in it; and it is for the want of attending to this little manœuvre that those who use the blunt hook so frequently find a difficulty in withdrawing it. When the hook, holding the iris, has been fairly brought out of the wound, an assistant, with a pair of fine scissors, snips through the iris, close to the hook, if a good portion of iris has been secured; but should the iris have torn, and only a small portion been withdrawn, it may be desirable to cut through it close to the cornea. Sometimes the tissue of the iris is so much softened that it breaks in coming out, and then the surgeon must use a fine forceps to catch what remains, and so prevent its retracting into the anterior chamber.

Any little shreds of iris that hang in the wound should be returned by means of a little spatula, so that the lips of the wound may come into exact apposition.

The description just given of the mode of using the blunt hook, and of other details in the operation for artificial pupil, will apply to the different modifications subsequently described. The wire speculum, and forceps to steady the globe, will always be found useful, often indispensable. The patient should lie down on a couch; and the best light is usually obtained by the foot of the couch being turned towards the window; the surgeon standing or sitting behind the patient's head. The use of chloroform will be regulated by circumstances; it is commonly necessary with children, or very intractable patients; but the pain of the operation, when skilfully performed, is so trifling, that patients possessed of self-control can usually dispense with chloroform altogether.

b. The next class of cases in which the blunt hook should be employed is that where iritis has terminated in adhesion between the whole or the greater part of the pupillary margin and the capsule of the lens.

At p. 113, under the head 'Sequelæ of Iritis,' I have described such a condition of closed pupil, accompanied by a bulging forward of the iris, in consequence of the pressure of the fluid secreted in the posterior chamber of the aqueous humour. When the whole surface of the uvea has become adherent to the capsule of the lens, these pouch-like dilatations of the iris do not exist. When only the extreme edge of the pupil adheres, the rest of the uveal surface remaining free, the contracted pupillary area, blocked up with opaque membrane, remains fixed, while the iris bulges all round it, so as in some places to touch the cornea. Partial adhesions of the uvea to the capsule give rise to deep grooves, subdividing the iris into separate pouches; the accumulation of fluid behind the iris being unable at these points to thrust it forwards.

When the whole cornea is clear, and the surgeon can select the position in which to make an artificial pupil, he will find it best to extend it either directly outwards, or directly downwards; and in a case of pouched iris, such as I am now considering, if a depression in the iris exists in either of these directions, he may take advantage of the circumstance to insinuate the cutting-needle and hook between the cornea and iris, without risk of wounding the latter.

When, however, he has succeeded in catching the edge of the pupil, and drawing out a piece of iris, he may perhaps be disappointed to find that he has removed only its fibrous portion, and that the aperture he has made is still blocked up by a layer of uveal pigment, adherent to the anterior capsule. Although in such a case the first operation may have done but little towards restoring sight to the patient, it will be found to have greatly facilitated a second operation, as the fluid which had been pent up in the posterior aqueous chamber can now find its way into the anterior chamber, and, in consequence, the whole iris will lose its pouched appearance, and recede from the cornea. When the slight irritation caused by the first operation has passed off, the cutting-needle may be introduced at a new point of the cornea, the edge of the artificial pupil caught with the blunt hook, and drawn in such a direction as to remove a portion of iris which had never been adherent to the capsule. If the periphery of the lens be transparent, this second operation will at once open a way for the rays of light to pass to the retina.

c. Extensive ulceration at the centre of the cornea, stopping short of actual perforation, may leave a cicatrix so large and opaque as entirely to cover the pupil, restricting the patient's sight to the perception of large objects placed very much out of the line of direct vision. The iris itself, when viewed through the transparent periphery of the cornea, may present a perfectly healthy appearance, and there may be every reason to suppose that the whole globe, with the exception of the cornea, has been unaffected by disease. In such a case, the object of the surgeon will be to displace the pupil either outwards or downwards, accordingly as he finds the outer or the lower portion of the cornea preferable in respect of transparency. The blunt hook is the most convenient instrument for effecting this displacement, as it does not endanger the lens, which I am supposing to be perfectly healthy. An opening having been made, either at the outer or lower margin of the cornea, in the manner described at p. 119, the free margin of the pupil is to be caught with the hook and drawn out, a larger or smaller piece of iris being cut off according to the size of the corneal opacity beyond which the pupil is to extend.

4. *Ligature.*—In spite of every precaution, it is not always possible to limit the size of the pupil, which sometimes opens out to an extent greater than was originally intended. To remedy this inconvenience, Critchett suggested an operation which he termed 'Iriddesis,' * and which is applicable to a limited number of other cases of artificial pupil besides that just described; as, for instance, where prolapsus iridis has occurred, and so much of the pupillary margin has been drawn into the cicatrix as to reduce the area of the pupil to a very minute aperture; or where the whole pupil has been displaced towards the extreme edge of the cornea, and there overshadowed by an opacity. A puncture is made through the cornea sufficient for the introduction of a cannula-forceps; a small portion of the iris near its ciliary attachment is grasped, drawn out through the wound, and tied there with a very fine silken thread. This transforms the pupil into an elongated slit. Should this aperture be found insufficient, it may afterwards be enlarged by tying a second portion of iris in such a position as to draw the pupil into a triangular form.

The operation by *ligature* has the advantage of leaving the margin of the pupil uninjured; and in some cases it has been found that even a certain amount of dilatation and contraction of the aperture has been maintained.

It is far from my intention, in treating of ophthalmic surgery, to attempt a record of all the schemes that have been suggested or put in practice. To describe the operations and instruments which artificial pupil alone has called forth, would be to enumerate a long and tedious catalogue of inventions, most of which have been long since abandoned as useless.

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* *Iriodesis* or *Iridodesis* would be a more correct word to imply tying (δέσις) of the iris, inasmuch as the genitive of ἶρις is ἴριος or ἴριδος.

After-treatment of an artificial pupil.—The various forms of operation I have recommended in the foregoing pages, if skilfully performed, inflict so little injury on the eye, that, provided the parts be in a fit state to undergo the operation—all inflammation being extinct, and the patient's general health having been properly attended to—little more than repose of the eye is required to enable the cornea to heal; and when that is effected, the wounded iris soon regains its natural texture and appearance. We are often, however, obliged to operate on an iris which has undergone long-continued and repeated attacks of inflammation. The tissue of such an iris is soft and spongy, and its enlarged vessels, when torn or cut, pour out their blood into the anterior chamber, where it may remain for many weeks, or even months, without being absorbed. On the contrary, when the iris is sound, and the patient's health good, but little blood is effused into the anterior chamber, and that little commonly undergoes absorption in the course of a few days.

After an operation for artificial pupil, *both* eyes should be lightly bandaged, or the lids closed with strips of plaster. On the second or third day the eye may be examined. Should there be much sclerotic redness, or intolerance of light, the operated eye must be again closed for a day or two. In most cases, at the end of a week from the operation, a large eye-shade will be sufficient; but the patient must be warned against too soon exposing the eye to strong light; and if the case be one in which the patient has for several years been limited to perception of light, he must be forbidden to strain his newly-regained powers of sight by premature examination of small objects. A pair of tinted glasses should be worn for some time after he has begun to go out of doors.

If the operation has been performed under chloroform, it will not be advisable to give any opiate or narcotic at night; but in excitable patients, who have not taken chloroform, it is sometimes necessary to give some mild narcotic. From twenty-five or thirty minims to a drachm of tinct. hyoscyami, in camphor-mixture, is what I usually order as a night-draught for an adult who has not been habitually addicted to the use of opiates. But many patients do not require anything of the kind. There is no reason for denying the patient a moderate quantity of plain animal food on the day of the operation, as well as on the following days. Nor should stimulants be wholly forbidden to those who are accustomed to their daily use. I need hardly say that a patient who is to spend the first day after the operation in bed, and perhaps the rest of the week in the house, is not to live as freely, and have the same amount of stimulants, as if he were taking daily exercise, and were engaged in active pursuits. But, on the other hand, it is absurd to keep a patient on low diet, and deprived of all accustomed stimulants, because a small puncture has been made in his cornea, and a little bit of his iris removed. Old and feeble persons cannot bear such reduction; and if any considerable quantity of blood has escaped into the anterior chamber, the best way to hasten its absorption is to keep the patient's powers up to a healthy standard, by plain nutritious diet, and just such an amount of stimulants as will maintain the circulation at a proper point of vigour.

It is difficult to conceive how surgeons who wrote and practised within the last forty years, could have thought it necessary to resort to the depleting and starving treatment we find them recommending as necessary, after the operation for an artificial pupil. Little more than forty years ago, the late Mr. Guthrie,* in a work professing to teach the operative surgery of the eye, wrote as follows: 'As a general rule, the patient should be *bled largely after any of the operations* for the formation of an artificial pupil;' and he goes on to say, that this bleeding is to be to the extent of fourteen ounces, in some instances to twenty-four, or from that to thirty ounces; that if the diminution of pain be only temporary, and after a few hours begins to increase [which, in an irritable or neuralgic patient, it would be quite sure to do, after all this loss of blood], recourse must again be had to bleeding; and that if *this* should not be sufficient to arrest the progress of the disease, it must be immediately treated as a case of iritis, and mercury administered in such a manner as to affect the system as rapidly as possible.

Such was the treatment by which a simple, delicate, and almost painless operation was perverted into a cause of suffering and misery.

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* *Lectures on the Operative Surgery of the Eye*, 2nd edit. 1827, p. 510.

CHAPTER VII.

DISEASES OF THE CHOROID AND RETINA.

(*Amaurosis—Amblyopia—Impaired Vision—Hebetudo Visus—Choroiditis—Retinitis.*)

The synonyms at the head of this chapter—and their number might be greatly multiplied by quoting from the older writers on eye-diseases—will at once show the difficulty that has always existed in assigning definite terms to those defects of sight which depend upon diseased states of the choroid and retina.

While some writers have classified these diseases *subjectively*, as they are evidenced to the patient by his own perceptions, and have spoken of 'impaired vision,' 'amblyopia,' and 'amaurosis,' others have attempted an anatomical arrangement, which before the invention of the ophthalmoscope was purely speculative and arbitrary, and have assumed inflammation of the choroid or retina to be the material *objective* cause of the phenomena.

The ophthalmoscope has already dissipated much of the mystery which formerly surrounded the deeper tissues of the globe, and has enabled us to demonstrate morbid changes, the very existence of which could only be vaguely suspected before the ophthalmoscope was invented. But when we remember how considerable a portion of the visual apparatus is contained within the cranial cavity, there must always remain a large class of defects of sight, which, like other cerebral diseases, can admit only of a theoretical and uncertain diagnosis.

Choroiditis.—Of course a structure like the choroid, almost wholly composed of a mass of blood-vessels, cannot fail to play an important part in all hyperæmic conditions of the eyeball. But that choroiditis, as a separate and independent disease, can be distinguished by such well-defined symptoms as are described in the older ophthalmic works, is disproved by the revelations of the ophthalmoscope. Patients are daily to be met with who have long suffered from defective sight, in degrees varying from a state in which it is difficult to read or to distinguish minute objects, up to that condition of dimness in which merely the form of large objects can be faintly discerned: to ordinary observation the eyes may appear quite sound, the pupils being active, and every tissue presenting the aspect of perfect health; and yet the ophthalmoscope may at once reveal morbid changes, which could only have been produced by extensive and long-continued disease of the choroid, portions of this structure having undergone atrophy to such an extent as wholly to have disappeared, leaving the sclerotic exposed to view; masses of pigmentous deposit overspreading the greater part of the choroidal surface, or effusion of serum having occurred in such quantity as to have detached a considerable portion of the retina from its position.

Retinitis.—As with the choroid, so it has fared with the retina, in respect of its supposed diseases and their symptoms. In the older ophthalmic works precise and distinctive descriptions are given of the symptoms of retinitis, which we now know to be altogether fanciful and imaginary. One of the most extensive forms of retinal inflammation, that originating in syphilis, is proved by the ophthalmoscope to be a not unfrequent associate of the disease which still retains the restricted name of 'iritis;' and yet, while this syphilitic inflammation of the retina is going on, there are none of the symptoms of retinitis, as formerly described by ophthalmic writers.

In patients who have long experienced impairment of vision, terminating in total loss of perception of light, the ophthalmoscope not unfrequently exposes to our view an amount of deposit on the retina, both opaque and pigmentous, such as could only have resulted from active inflammation; and yet, the progressive failure of sight has been painless, and quite unattended by any symptoms analogous to those formerly received as indicating retinitis.

If it be said that these are instances of *chronic* inflammation, and that the *acute* form must certainly be attended with all the phenomena of hyperæsthesia of the retina, the ophthalmoscope again contradicts the old opinions. Cases occur in which a sudden cloud appears to come before one eye, shrouding all objects in a dense mist, or wholly destroying the perceptive power of a large portion of the retina. No pain whatever occurs in the eye, nor is the patient sensible of any luminous appearances; while the iris and all superficial parts remain perfectly unchanged. Let the pupil be dilated, and the ophthalmoscope applied, and the greater part of the retina will be seen overspread with blood, poured out from some ruptured retinal vessel; and yet the hyperæmia, which must have preceded such rupture, may have been unattended with any subjective sensations of light.

In fact, the terms *retinitis* and *choroiditis* originated in a desire to apply a precise and anatomical nomenclature to morbid conditions altogether obscure. Before the invention of the ophthalmoscope, this nomenclature passed unchallenged; for neither the active disease, nor the morbid changes resulting from it, could be investigated in such a manner as positively to prove or disprove the surgeon's diagnosis; and he pronounced a case to be choroiditis or retinitis, according to the preconceived notion he might have formed as to the effects which such inflammations would produce on vision.

The term 'amaurosis,' which but a few years ago formed a heading to the longest chapter in every work on eye-diseases, and a title to many an elaborate monograph, must now be consigned to oblivion; unless it be retained to designate those conditions of dim or lost sight the causes of which, being within the cranial cavity, are therefore beyond the range of actual inspection.

Morbid Appearances of the Retina, Optic Nerve, and Choroid.

Any verbal description of the various changes in the deep tissues of the eye, which the ophthalmoscope exhibits to our view, must of necessity be very imperfect; such a description may, indeed, recal to memory peculiarities of form and colour which have already been studied in the living subject; but to the beginner it can suggest only a faint and shadowy picture. In many instances, too, we must content ourselves with describing appearances, the real nature of which we are at present unable to explain.

Retina and optic nerve.—In old persons, whose dimness of sight would suggest the existence of commencing cataract, we occasionally find a *white patch* of variable extent, and very irregular outline, immediately surrounding the optic nerve. Sometimes this patch is of such extent as to encroach upon that portion of the retina corresponding to the axis of vision. These patches are of an opaque dead white, and are quite devoid of vessels. They seem to be due to chronic hardening and condensation of the nervous tissue, with obliteration of the vessels. In some instances, perhaps, fatty degeneration may also be present.

In several cases of Bright's disease, accompanied with great dimness of sight, yellowish-white spots have been seen scattered over the surface of the retina. I am acquainted with only one case in which the fatty nature of these deposits has been proved by dissection.*

The changes in the retina and optic nerve consequent upon syphilitic inflammation have been already noticed in the section on iritis (p. 107).

A very remarkable appearance connected with the optic nerve in myopic persons, consists in a white patch, of a crescentic shape, so immediately in contact with the margin of the nerve as to seem at first sight to form part of the nervous tissue itself. The nerve in these cases is always found to deviate from its normal circular form, and to assume more or less that of an oval, in contact with the narrow diameter of which the white patch is found. As a rule it is placed to the outer side of the optic nerve, but it may be found above, below, or to the inner side. This crescentic patch has been described by German writers under the name of 'staphyloma scleroticæ posticum,' from a supposition that there is always at this spot an actual protrusion of the sclerotic.† This does not appear, however, to be invariably the case.

In an eye which presented the crescentic patch in a very marked degree, it was found on dissection that the pigment-cells of the choroid were altogether wanting throughout the whole extent of the crescent; so that the light from the ophthalmoscope, passing through the transparent retina and wasted choroid, was reflected from the sclerotic itself, which at this point was thinner than natural, but not at all prominent or staphylomatous.*

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* The case is reported by Heymann, in the *Archiv für Ophthalmologie*, vol. ii. p. 139, 1856. During the progress of the disease the patient became maniacal, so that the ophthalmoscopical examination was difficult. The loss of sight was almost total in both eyes. The media were clear, and an irregular yellowish-white patch was observed just below the optic nerve. Both eyes were examined after death, and presented nearly similar appearances. At a distance of a line or two from the optic nerve, about twenty yellowish-white spots, of various sizes, were arranged in an irregularly circular figure. The largest spot which had been seen during life was situated below the optic nerve, and about a millimetre in diameter. A microscopical examination of the spots, proved them to be isolated portions of fatty degeneration in the ganglionic structure of the retina.

† E. Jæger, *Beiträge zur Pathologie des Auges*, 1858, plate. xvii. A representation is here given of a well-marked crescent, fringed with pigmentous deposit, which was observed in a very short-sighted patient. Plate xviii. shows a still larger crescent, in a case of more advanced myopia. This figure also exhibits the choroidal vessels with that extreme distinctness which is caused by absence of the hexagonal pigment.

Among the more striking appearances under the ophthalmoscope are the irregular deposits of *black pigment* on the illuminated field of the retina. These pigmentous deposits present endless varieties as to quantity and mode of arrangement. In one case two or three minute isolated dots may alone be visible; in another case the pigment may assume the form of fine threads, ramifying over a considerable portion of the retinal surface; while, in a third case, the pigment may be aggregated in large black masses, the intervening portions of retina being of healthy appearance. (Plate II. fig. 2.)

Pigmentous deposits are met with at all ages, and generally appear to be a sequel of chronic inflammation, although it very often happens that the patient can give no account of such an attack. Pigment is also commonly seen interspersed in large quantities among the white patches which result from syphilitic disease of the retina.

When a vessel, in either the choroid or the deeper portion of the retina, has given way, and broken up the tissues immediately surrounding the extravasation, absorption of these tissues, as well as of the blood, may subsequently take place to such an extent as to lay bare the sclerotic. A rounded white patch is thus produced, which is usually fringed with a black edge of pigment. In other cases the whole site of the extravasation becomes covered with pigment, so that, instead of a black ring, an irregular black disk is the result. I have met with several instances in which a fringed or blackened patch of this kind was situated directly in the axis of vision. Sight was very imperfect, and limited to a very small space; so that, in the attempt to read a large type, only a single word, or part of a word, could be taken in at a glance.

Extravasations of blood, either from the retina or the choroid, constitute, I need hardly say, the most serious accidents to which those tissues are liable. The blood may be effused in consequence of a blow on the eyeball, or it may escape spontaneously from a distended vessel giving way, as in ordinary apoplexy.

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* See a plate in the first volume of the *Ophthalmic Hospital Reports*, figs. 4 and 5. The nerve in both these figures is over-coloured, so as to present too marked a contrast to the whiteness of the crescent. The dissection by Dr. Bader, alluded to above, will be found at p. 117 of the volume just quoted. Good representations of the myopic patch in various forms are depicted in tab. iii. of Liebreich's *Atlas*.

It is remarkable that rupture of a retinal vessel sometimes occurs without any of the symptoms which one might expect would accompany it—such as giddiness and other signs of cerebral disturbance. I have seen many cases in which a dimness or cloudiness has suddenly overspread one eye, while the patient, in apparently good health, was quietly engaged in reading or writing; no pain or uneasiness of any kind accompanying the attack, the iris retaining its mobility, and even the conjunctiva and sclerotic showing no trace of increased vascularity. The patient finds that a considerable portion of his field of vision has become a total blank as regards perception of objects; while, perhaps, he still retains the power of dimly discerning those which happen to fall on some limited portion of the retina. If such a case is examined within a few hours, or even a few days after the rupture of the vessel, the fresh red colour of the effused blood will at once be recognised. If it is one of the radiating vessels of the retina that has given way, the prognosis will be much more favourable than if the hæmorrhage had come from the choroid; for, in the former case, the tissue of the retina, although for a time overspread with blood, and so rendered incapable of receiving visual impressions, may have escaped any serious disintegration; whereas, if the blood has proceeded from the choroid, it may have actually ruptured the retina, and irreparably destroyed that portion of it as far as its function is concerned. The presence of clots freely floating in the vitreous humour would be a still more unfavourable sign, as it would prove that the tissue of the vitreous body had, to a certain extent, been broken up. This latter complication more frequently results from blows on the eyeball than from spontaneous apoplectic extravasation.

No one who has had a little practice with the ophthalmoscope can find any difficulty in detecting a recent extravasation of blood on the surface of the retina; but the recognition of the changes which mark the site of old extravasations is often extremely difficult. I have already noticed the cases in which a rupture of choroidal vessels breaks up and destroys a limited portion both of the choroid and retina, leaving either a well-defined space of white sclerotic, or a patch of dark pigment, to mark the site of the disruption. But a less extensive extravasation, originating in the rupture of a superficial vessel of the retina, may leave such faint traces as almost to escape observation. Sometimes the site of the rupture is marked by a slight brownish stain, in other cases by a faint mottling of the retinal surface; while a more extensive extravasation may so far damage the retina as to leave in after-years a linear or stellated cicatrix (if one may so term it), of a lighter colour than the surrounding tissue.

Serous effusion between retina and choroid.—This effusion may occur as a result either of acute or chronic inflammation; *chronic* effusion between the retina and choroid may take place in the most gradual and insidious manner, so as only to manifest itself by impairment of vision, unattended with any pain or external signs of inflammation.

When the retina has become detached to a very considerable extent, a corresponding portion of the field of vision becomes a total blank so far as perception of objects is concerned; while that portion of the retina which remains in apposition with the choroid may still distinguish even small objects, although in an imperfect and partial manner.

There are no external signs by which we can ascertain the existence of effusion beneath the retina. The ophthalmoscope alone enables us to detect it.

The effused fluid may either exist in such a small quantity as barely suffices to impart a cloudy appearance to a limited portion of the retina; or it may have detached a considerable extent of the retina, or even the whole of it, from its connection with the choroid.

The more limited effusions frequently occur in the immediate neighbourhood of the optic nerve. At first sight they appear as greyish or cloudy patches in the midst of healthy tissue, and the radiating vessels which are spread out over the rest of the fundus of the eye appear to be lost when they arrive at the edge of the patch. This appearance is owing to the fact of the vessels being raised up by the effusion beneath them, so that they are on a plane different from that of the vessels of the healthy retina. A slight movement of the convex glass, which the ophthalmoscopic observer is employing, will at once bring into focus the vessels overlying the effusion.

When a large portion of the retina has been separated, it presents the appearance of a lobular mass, of an opaque greyish colour, contrasting in a remarkable manner with the reddish surface of that part of the retina which still retains its natural position. Sometimes the lobular mass may be observed to oscillate with each movement of the eye; and when brought into focus the surface of the mass is seen to be overspread with ramifying vessels, the displaced veins of the retina.

When almost the entire retina is detached from the choroid, the appearances under the ophthalmoscope are at first very difficult to understand. The whole fundus of the eye appears at one moment of a dull grey, as if covered with a milky gelatinous deposit; then the white disk of the optic nerve comes for an instant into view, and then again a sudden turn of the eyeball affords a glimpse of some very limited portion of undisplaced retina, which still dimly reflects the luminous rays which fall upon it. Not unfrequently the view of the fundus is still farther confused by floating bodies dispersed through the vitreous humour.*

Coloboma of the choroid.—This very curious congenital malformation is associated with coloboma iridis (p. 92), and it presents under the ophthalmoscope a most remarkable appearance. The optic nerve is with difficulty distinguished, as it is in the midst of a large, oblong patch of white, across which some long scattered vessels are seen to ramify. This white patch is the sclerotic, exposed to view by the great gap in the choroid. The sheath of the optic nerve is also said to be imperfect in these cases.†

Optic nerve.—I have already described the appearance of this nerve in health, and have incidentally noticed a few of its morbid changes, such as are found in connection with myopia, and with syphilitic inflammation of the iris.

Very great variations in the form and colour of the nerve are compatible with good sight. As age advances, the tissue of the nerve appears to become denser, less succulent, so as to occupy a smaller space than in early life. Its colour also becomes darker, and in some old persons approaches to grey, while its outline slightly deviates from that circular form which one must assume as the standard of perfect health. Indeed, it is extraordinary to see how much variety in its size, form, and colour may co-exist with a fair amount of vision.

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* It is almost impossible for an artist to give a correct representation of a detached retina. A very able attempt to do so, and indeed the only one I have seen which has any resemblance to nature, is in Liebreich's *Atlas*, tab. vii. fig. 2.

† Liebreich, tab. xii. fig. 5.

A very common appearance is that of a thin line of black pigment skirting the margin of the optic nerve to the extent of a sixth, a quarter, or the half of its circumference. Strictly speaking, we must regard this pigmentous deposit as morbid; but its existence cannot be of any great importance, inasmuch as we so frequently meet with it in eyes which, if judged by their power of vision, may be termed healthy.

Inflammation ('optic neuritis') attacks the nerve in various forms. Sometimes it is evidenced by extreme hyperæmia, the whole disk assuming a pink or reddish colour. After this redness has existed a considerable time, attended with great dimness of sight, it slowly passes off, but the nerve does not resume its healthy aspect. On the contrary, it either presents a dead white appearance, or a dirty-grey tint; in either case the blood-vessels remain much diminished in size, and vision is almost or altogether lost.

This form of optic neuritis is occasionally met with as a result of excessive indulgence in tobacco.

That too great use of this narcotic has, in certain constitutions, a direct tendency to induce disease in the optic nerve, can no longer, I think, be doubted. I say 'in certain constitutions,' for it is notorious that a vast proportion of those who smoke tobacco do so with impunity so far as sight is concerned.*

Another form of neuritis either co-exists with syphilitic iritis, or is liable to come on several weeks or months after all inflammatory appearances in the iris have passed away. The area of the pupil may be quite free from deposit, there may be no trace of redness in the sclerotic, and yet the sight becomes as dim as it was during the height of the iritic inflammation. In such a case the ophthalmoscope alone can enable us to form a diagnosis. The optic nerve is either wholly hidden by a filmy cloud of lymph, or its outline can be dimly traced through the cloud, which not only involves the optic disk itself, but obscures the adjacent portion of the retina. If a case of this kind is neglected, the lymph eventually forms an opaque white patch overspreading the optic nerve, and, according to the amount of deposit, sight is either greatly obstructed or wholly destroyed. If the case be seen at an early stage, a careful mercurial treatment, either with or without iodides according to circumstances, may cause complete absorption of the lymph.

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* My limits do not permit me to enter fully upon this most important subject, but I will mention just one case, on account of its peculiar circumstances A literary man, of large and active brain, a voluminous writer on varied topics, came under my care for gradually diminishing reading-power. He had been for years a hard worker, reading and writing many hours each day. His hobby was tobacco-smoking, which he believed to be essential to the due action of his intellectual powers, and except during the time devoted to sleep and to meals, the pipe was seldom laid aside. He wrote a history of tobacco, and held public disputations in defence of its use. He lived by his pen, and when he began to find reading and writing a little difficult, he only smoked the more. I found all the media clear, both optic nerves small and anæmic, and the retinal vessels diminished in size. He could no longer read ordinary type, and when I last saw him he was compelled to give up literary pursuits altogether.

One of the most remarkable changes to which the optic nerve is liable, is that observed in cases of blindness from cerebral disease, involving that portion of the nerve which is contained within the cavity of the skull. In old-standing cases of this kind we find evidences of chronic congestion of the retina, and degeneration of the optic disk. The fundus presents a uniform red colour, sometimes so strongly marked that no trace of separate choroidal vessels can be seen, and the vessels radiating from the centre of the nerve are almost lost in the deeply-tinted surface on which they lie. Contrasting strongly with the redness surrounding it, the optic nerve at once attracts attention by its extreme whiteness, which resembles that of ivory, rather than the creamy or faintly pinkish tint which I have described as characterising the nervous tissue in a state of health. These dense-looking, homogeneous nerves have undergone *white atrophy*, and have lost the greater portion of their true nervous element, little more than the fibrous tissue remaining. (Plate III. fig. 2.) The combined appearance of a red, thickened retina, and a homogeneous, white, optic nerve, at once assures the practised observer that the case is quite beyond recovery.

In a practical point of view there is no change in the optic nerve more important than the pitting or *excavation* which is connected with glaucoma. This appearance can be well seen only in the early stage of the disease, for after a while a change in the corneal epithelium takes place which prevents any clear view of the fundus of the eye. When the concavity of the nerve is considerable, the retinal vessels are seen to bend abruptly as they are passing over the edge of the depression. (Plate I. fig. 2.)

The colour of the nerve is at first not much altered, but after a time it assumes a greyish tint, which, under certain conditions of illumination, appears darker than it really is. These changes will be again alluded to in the chapter on glaucoma.

Cases of greatly impaired sight are met with in which the optic nerves are found as deeply excavated or cupped as in the most advanced stage of glaucoma, while there is an absence of all the other signs of this disease; the corneæ being clear and smooth, the irides active, and the globes not harder than natural. Simple wasting (*grey atrophy*) of the nerve seems to be the cause of its concave appearance.

Atrophy appears sometimes to affect the whole retina and optic nerve, without any previous inflammatory process. This condition is chiefly met with in old persons; it also may befal those in the middle period of life. The power of sight gradually fades away year by year, until eventually mere perception of light remains. The ophthalmoscope reveals a perfectly clear condition of the media, and at the same time affords such a complete view of the choroidal vessels, that the observer could almost fancy the retina to be altogether absent. The optic nerve is small and shrunken, irregular in its outline, and of a dark grey or drab colour; and the vessels emerging from it form delicate, hair-like, red lines, barely traceable across the area of the illuminated choroid.

In some instances I have seen this extreme atrophy of the retina accompanied with a very remarkable change in the choroidal vessels, their colour being pale orange or buff, instead of red.* This appearance I have met with only in old people; and their failure of sight has been so slow, and unattended with marked symptoms of any kind, that they have been supposed to be the subjects of steadily advancing cataract.

Treatment.—If the reader now refers back to the sketch I have given of the morbid changes in the retina and choroid, he will at once perceive how impossible it must be to lay down any rules for treatment that will be uniformly applicable to all so-called 'amaurotic' cases. In a group of patients, complaining of almost the same defects of sight, one will be discovered to have a portion of the retina overspread with blood; in a second, the axis of vision will be occupied by a patch of pigment; while in a third, the retina and choroid will be partially separated by serous effusion.

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* See E. Jäger, *Beiträge zur Pathologie des Auges,* taf. vi.

Are these three patients to be treated alike? Do they, in fact, possess anything in common? And yet formerly they would all have been classed together as 'amaurotic,' and probably have undergone salivation accordingly.

If the ophthalmoscope had done nothing else than limit the wholesale administration of mercury in eye-diseases, it would have conferred an immense boon upon mankind.

Even when it has been ascertained that an extravasation of blood has taken place from the vessels of the retina or the choroid, the treatment will require great care and discrimination on the part of the surgeon. In one case the extravasation will have been accompanied, or immediately preceded, by giddiness and other symptoms of disordered circulation in the brain, and may have been induced by alcoholic or other stimulus, or by great muscular efforts in a plethoric and vigorous subject. Rest and abstinence may be indicated as the first preparatives for treatment. In another case, rupture of a retinal vessel may have occurred in a feeble and delicate patient, during a period of perfect repose, and may have resulted from a diseased and softened condition of the coats of the vessel itself. I have seen extravasations take place in such subjects in consequence of sudden exposure to cold, especially when the body or mind had been previously much exhausted. Here, moderate stimulants would be beneficial, and the absorption of the effused blood would be hastened by medicines of a tonic character—iron or quinine.

In all cases of extravasation of blood from the vessels of the retina, the surgeon should take care not to make unnecessary examinations with the ophthalmoscope, as each occasion of exposure to its strong light increases the congestion of the part, and consequently the liability to farther extravasation. I have known several instances of this kind, in which a fresh escape of blood immediately followed the use of the ophthalmoscope. Having once clearly made his diagnosis, the surgeon may be satisfied as to the progress of absorption by the steady improvement of the patient's sight, and may postpone any farther use of the ophthalmoscope until recovery has been well established.

Where serous effusion has taken place between the choroid and retina, in addition to other general treatment, iodine internally, combined with blistering in the neighbourhood of the eye, may be tried; although, if the effusion be of old standing, and to a large amount, little, if any, benefit can be hoped for.

It must be evident that structures, like the choroid and retina, which derive their supply of blood from such remote and deep-seated sources, cannot be treated by local depletion, even if depletion were desirable. The surgeon must seek to restore the balance of the patient's circulation by general treatment, based on a careful and comprehensive survey of constitutional peculiarities and mode of life, and especially of the habits or pursuits which may be supposed to have given rise to the local changes. Inquiries must be instituted as to the existence of any of those causes which impair the sight by exhausting the patient's general nervous power. The abuse of alcohol, tobacco, or opium; venereal excesses; protracted suckling, and many other depressing agencies, will suggest themselves to the mind of the acute practitioner. He will take care not to trust too implicitly to this or that article of the pharmacopœia, and will especially be on his guard against the depressing agency of mercury—the drug which he will find lauded almost as a panacea for 'amaurosis' in some of the medical works of the last generation.

Galvanism and strychnine he will frequently hear spoken of as possessing wonderful efficacy in arousing the dormant powers of the optic nerve. The action of strychnine appears so entirely limited to the motory fibres of the nervous system, that to expect it to influence a nerve of special sense is to confuse all our notions of physiology. Galvanism has been at various times a favourite remedy with the public, and its administration admits of a parade of scientific apparatus which specially imposes on the popular mind.

Those who believe—or make their patients believe—that they can render cataractous lenses transparent by means of galvanism, will doubtless long continue to vaunt its efficacy also in cases of the most complete disorganisation of the retina.

An anatomical classification of eye-diseases—the arranging of them, that is to say, according to the changes of structure which cause the impairment of sight—has such obvious advantages that it has become almost universal among ophthalmic writers; but it has the inconvenience of offering no heading under which to place certain defects which cannot be precisely demonstrated as originating in any one part of the optic apparatus.

Of this kind are the various luminous appearances depending upon some temporary disturbance of circulation—occasional obscuration of half the field of vision (*Hemiopia*)—the condition termed *Hemeralopia*—congenital inability to distinguish certain colours—spectral illusions, &c.

Faulty perception of colours.—The following list comprises only a portion of the many terms invented to designate this affection: *achromatopsia, chromatopseudopsia, chromatometablepsia, chromatodysopsia, chromatopseudoblepsia, dyschromatopsia.* These words, it will be observed, all imply difficulty or inability to *see colours*; but in fact the subjects of this affection are not insensible to all, but only to some colours, while others are seen perfectly. The term *colour-blindness*, employed by Wilson,* is on this account objectionable. *Daltonism* † commemorates the faulty perception of an individual, without conveying any notion of the nature of the defect. I have suggested the word *acritochromacy*,‡ as implying 'inability to discriminate between colours,' which pretty nearly defines the true nature of the affection.

On investigating the reported cases of 'acritochromacy,' the defect appears in most instances to resolve itself into inability to perceive red; and the compound tints suggesting doubtful impressions are those into which red enters to a greater or less extent. Yellow seems to be always appreciated, and blue almost always.

The cause of the defect probably resides not in the eye itself, but in that portion of the brain to which the impressions of light are ultimately conveyed. Hitherto very few dissections have been made of the eyes of 'acritochromatic' persons. Dalton had supposed a blue tint of the vitreous humour to be the cause of his own peculiarity, and, in accordance with his express wish, his eyes were examined after death, but nothing unusual was discovered.

Acritochromacy may take place as a temporary morbid symptom.

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* See *Monthly Journal of Medical Science*, Edinburgh, July 1854, p. 1.

† From Dalton the chemist, who published his own case in the *Memoirs of the Literary and Philosophical Society of Manchester*, 1798, vol. v. p. 28.

‡ 'Ακριτοχρωματία.

Some years ago a very intelligent and sensitive little girl, ten years old, was brought to me in consequence of almost total blindness, which had come on within the preceding four days. She was unable to guide herself, and, if left alone, could not avoid the articles of furniture in the room. She with difficulty perceived a sheet of paper lying on the floor, and, of course, was wholly unable to distinguish the largest type. She had been much excited by the emulation of a school-competition, and had taxed her memory considerably in learning by heart. Slight dilatation and sluggishness of the pupils were the only ocular symptoms; but she dreamed vividly, occasionally felt faint during the day, and had numbness and formication in the left leg and foot. I enjoined complete rest, and prescribed iron in small doses. Within a week she could trace lines of type as streaks, but was quite unable correctly to appreciate colours. She had no difficulty with yellow and blue, but mistook all tints containing red. Ten days later her general health was restored, and with a little pains she could read the type of a leading article in the *Times*; but her appreciation of colours was still imperfect. At the end of a few weeks all defect of sight was gone; she read the smallest type, and her power of discriminating colours was quite restored.

Wilson has insisted upon a very important practical point connected with 'colour-blindness,' as he terms the defect, namely, that persons employed on railways and elsewhere, where coloured lights are used as signals, should be previously tested as to their power of perceiving colours with perfect accuracy. On many occasions our lives depend on the ability of some solitary signal-man to distinguish between green, the sign of safety, and red, that of danger. Now that an universal railway system has forced upon us a mode of travelling fraught with incessant peril to life and limb, we cannot afford to neglect a single chance of safety.

There seems to be no cure, or even palliation, of a defect which appears to depend upon a congenital want of appreciative power in the brain itself.

Hemeralopia—literally 'day-sight'—is a term used to designate a peculiar form of intermittent blindness, the subjects of which see perfectly in broad daylight, but lose all power of perceiving objects as soon as the sun has set, and twilight commences. The persons in whom the affection is most frequently met with in this country are those just returned from sea-voyages, especially from the East or West Indies. It is also frequent, I am told, among the natives of the inland parts of India, who attribute it, as our own sailors do, to sleeping exposed to the moonbeams.

The real cause of hemeralopia appears to be exhaustion of the nervous power of the retina from over-excitation by the sun's rays, so that the part is rendered incapable of appreciating the weaker stimulus of twilight or moonlight. Exposure to tropical light, however, is not the sole cause of the affection; for I have met with it in persons who had never quitted the temperate regions of the globe; but in most of these latter cases the complaint had shown itself after long voyages, which had subjected the patients to exhausting toil and exposure to severe weather, while deprived of a proper supply of fresh provisions and vegetables.

In these latter cases I have commonly found that a few weeks' residence on shore, with a mixed vegetable and animal diet, and the use of quinine, has restored vision to a healthy state.

Nyctalopia—'night-sight'—would imply inability to see by daylight, the exact converse of hemeralopia. In a certain sense, patients affected with that irritable form of corneal inflammation commonly called 'strumous ophthalmia,' might be termed nyctalopic, so unable are they to bear strong light, and so willing to open the eyes and look about them in the dimness of twilight; but, apart from inflammation, I have never met with nyctalopia to the extent described by authors; and I am inclined to consider the affection an imaginary one, invented, as it were, to form a companion disease to the hemeralopia just described.

CHAPTER VIII.

DISEASES OF THE VITREOUS BODY.

Before the invention of the ophthalmoscope, little was known about the morbid conditions of the vitreous humour. It was frequently found to become diffluent (*synchysis*) after injuries to the eyeball, and during the progress of certain chronic inflammations; and it was assumed to play an important part in glaucoma. The ophthalmoscope presents to our view a great variety of morbid products in the humour, which it is difficult to observe with accuracy, on account of the rapidity with which many of the flakes, filaments, and corpuscles, float about with every movement of the eye.

When *hæmorrhage* occurs from the ciliary processes, or from the superficial vessels of the retina, a portion of the clot not unfrequently becomes entangled in the vitreous humour, and forms an irregular, filamentous, black-looking* body, floating to and fro across the illuminated field of the ophthalmoscope.

In *syphilitic inflammation* of the deep tissues, the vitreous humour loses its perfect transparency, and becomes turbid; and in severe cases, flakes of lymph are seen freely moving about in it, like tangled blackish threads.

A very singular phenomenon connected with the vitreous humour is that termed *sparkling synchysis* ('synchysis étincelant'), produced by the disintegration of an altered crystalline lens. This body, after becoming opaque from ordinary cataractous change, sometimes undergoes extensive fatty degeneration, crystals of cholesterine being abundantly formed within its substance. If a lens in this condition is broken up with the needle, or becomes ruptured and thrown down to the bottom of the vitreous chamber by a blow, the crystals of cholesterine are set free, and at each movement of the eye appear as innumerable brilliant points, like the finest gold-dust, sparkling in the dark area of the pupil. When the eye is kept at rest these crystals gravitate to the bottom of the mingled aqueous and vitreous humours, some sinking down behind, and some in front of the iris.

Sparkling synchysis is very rare, and I have not had an opportunity of examining any cases with the ophthalmoscope.

Cysticerci.—Perhaps the most striking phenomenon connected with the vitreous humour is the presence of entozoa, either freely floating within it, or protruding into it from the surface of the retina, to which they are attached. By far the greater number of cases of this kind which have been recorded are to be found in foreign journals, for hitherto only a very few have been observed in this country. I have myself never met with a case.†

Of twenty cases reported in various numbers of the *Archiv für Ophthalmologie,* the majority appear to have been under the care of Graefe. In *eight* cases the cysticercus was either embedded in the very tissue of the retina, or firmly adherent to its surface; in *six* cases, the creature appeared to be behind the retina; while in *six* others it was quite detached, and floated freely in the vitreous humour. This latter circumstance induced Graefe, in two instances, to attempt its removal; in the first case, making an incision in the sclerotic and passing in a forceps through the wound; in the second, adopting a slower and more complicated proceeding. First, a portion of the iris was excised, so as to make a large artificial pupil; then, when all irritation had subsided, the lens was extracted through a flap-section of the cornea; and lastly, after a considerable interval of time had been allowed to elapse, a forceps was introduced through a fresh opening made in the cornea, and the cysticercus grasped and drawn out.*

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* I may here notice that floating bodies in the vitreous humour are not necessarily *black* because they look so under the ophthalmoscope. Any body sufficiently opaque to intercept the rays of light passing from the illuminated retina to the eye of the observer will appear black, although if examined out of the eye, it might be found light-coloured or even white.

† Teale gives the history of a case occurring in his own practice in 1864 (*Ophth. Hosp. Reports,* vol. v. p. 318). Bowman reports another (op. cit. vol. iii. p. 324). Hulke, in dissecting a disorganised and irritable eye, found a cysticercus between the choroid and retina.

From a review of all these cases, it appears almost certain that the cysticerci found loose in the vitreous humour had attained that position by perforating the retina, having been originally formed between that tissue and the choroid, in which situation it seems that all the cysticerci above described were originally developed.

In a more recent volume of the *Archiv*, Graefe gives the total result of his experience as to the occurrence of cysticercus (xii. 2, 174; 1866). During thirteen years 80,000 patients had attended his clinique, and among them rather more than 80 cases of cysticercus in the deep tissues of the eye had been observed: 3 had been seen in the anterior chamber; 5 under the conjunctiva; 1 in the substance of the lens; 1 in the orbit. The ages of the patients varied from eight years to seventy.

The very curious researches recently made into the natural history of intestinal parasites have proved that the *cysticercus telæ cellulosæ* and the *tænia* are really the same creature in different stages of development.†

I believe it has been well ascertained that the inhabitants of Northern Germany are more liable to tape-worm than those of the British Islands, and this circumstance would account for the fact of the cysticercus having been so much more frequently met with in the former country.

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* A case of cysticercus in the vitreous humour is related by Desmarres, *Traité théorique et pratique des Maladies des Yeux*, 2nd edit. 1858, vol. iii. p. 756. Another by Williams in the *Cincinnati Lancet and Observer*, May 1858. See Liebreich's *Atlas*, tab. vii. figs. 5 and 6.

† See Küchenmeister and Von Siebold, *On Animal and Vegetable Parasites* (Sydenham Society, 1857).

Muscæ volitantes.—The little threads and spots which, by some persons, are seen to float and glide over their field of vision, were formerly attributed very commonly to congestion of the choroid. Tyrrell, for instance, assigned as their cause 'a preternatural dilatation of some of the delicate vessels' of the part. It seems strange that any one could overlook the fact that *fixed* bodies—which dilated vessels of the choroid must be—if they pressed upon the retina so as to impair its function, would suggest to the patient the idea of *fixed* spots in the field of vision, which could only appear to move when the eyeball itself was set in motion. The spots known as *muscæ volitantes,* on the contrary, change their position whenever the eye is suddenly moved; and when the eye is again fixed, the spots still continue for a time to float about in various directions, eventually appearing to descend, as if sinking in a fluid.

They are most commonly met with in short-sighted subjects, and are quite compatible with life-long continuance of the acute powers of vision which such persons frequently enjoy. They are usually first noticed between the ages of twenty and thirty; and when they have begun to attract the patient's attention, they appear rapidly to increase in number. This apparent increase is partly due to the fact that, by anxiously watching them, the patient soon acquires a habit of bringing fresh bodies into view.

If the eye be turned towards a clear sky or a bright cloud, and then kept steadily fixed, the spots appear to sink slowly downwards, just as filmy particles would sink in a liquid, which had been shaken and then allowed to rest. A sudden turn of the eye will again cause the little bodies to disperse for a moment, and when the eye is once more fixed, they slowly descend as before.

So long as the patient steadily concentrates his attention on any external object, the *muscæ* are not seen; but if he accidentally catches sight of one of them the whole field of vision at once becomes crowded with them.

The best way of examining the floating bodies is for the patient to look directly downwards upon the illuminated field of a microscope. They will then be recognised as beaded filaments, variously twisted and bent; sometimes appearing as loose knots of coiled-up fibres entangled together. When thus grouped they have a greyish colour, but when a single filament is examined, it is seen to be made up of highly-refractive globules, varying in form and size. Sometimes a filament may be seen to bend, and again become nearly straight, or to turn in such a manner as to present itself in a foreshortened position. This latter circumstance proves that the bodies float freely in a fluid, and are not situated, as some have supposed, upon the surface of the cornea. This is still further proved by the fact that the blinking of the lids has no effect whatever upon the position of the *muscæ* in the field of vision. If, when the lids are closed, the eyes are turned towards a strong light—exposed to sunlight, for instance—the *muscæ* can still be seen, and their movements will be just as free as when they were observed with the eyes open.

Some interesting experiments were made on himself by Mackenzie,* to determine the seat of *muscæ volitantes*; but the most conclusive researches as to their nature are those by Jago,† who has satisfied himself that these disquieting spectres are, in fact, nothing more than the beaded filaments of the vitreous body itself. The normal network of these filaments, he says, can be seen by any one who knows how to look for them—under certain conditions, I presume, of impressibility of retina. Those filaments which, from being tangled together in irregular masses, form such annoyances to the patient, would appear to be the filamentous network in a disintegrated state.

There are few phenomena which give rise to more alarm in patients' minds than *muscæ volitantes*. A vague notion that they are the forerunners of amaurosis or cataract is almost universal; and even medical men are apt to confound these *floating muscæ* with the moving cloudy shadows resulting from effusions of blood or lymph within the vitreous humour, or with the fixed spots betokening that some limited portion of the retina has become insensible to light. A careful attention to the appearances of the *muscæ volitantes*, as I have described them, will enable the patient to convince himself of their real nature; and the surgeon may console him with the assurance that, although incurable, they are perfectly compatible with excellent and enduring sight.

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* First in the *Edinburgh Med. and Surg. Journal*, for 1865; and again in his *Practical Treatise*, &c. 1854, p. 951.

† *Entoptics, with its uses in Physiology and Medicine*, 1864, p. 93.

It is to be hoped that medical men in general will speedily arrive at this conviction; for it is lamentable to meet with patients who have gone through years of treatment, often of the severest kind—even to bleeding and salivation—or at best through an equally ineffectual course of tonics and local applications, and after all have remained with their *muscæ* undiminished, and their minds still burdened with anxiety and fears of approaching blindness.

Appearances so common as floating *muscæ* will of course be observed by multitudes of persons who subsequently may become the subjects of either retinal disease or cataract. All I mean to insist upon is, that the *muscæ* and the diseases of retina or lens have no causal relation to each other.

CHAPTER IX.

DISEASES OF THE LENS AND CAPSULE.

In a state of health the lens and the membranous capsule enclosing it are perfectly transparent. In early life they are also quite colourless; but after the age of thirty the lens in most persons begins to assume a pale-yellow tinge; and this gradually becomes more marked as age advances, until in old subjects it frequently acquires the colour of amber.

Any loss of transparency in the lens, whether affecting the whole or only a portion of it, constitutes *cataract*; and in strictness this term should be limited to changes in the lens and its capsule. To call an opaque inflammatory effusion in the area of the pupil a 'spurious cataract,' is to introduce a loose and uncertain terminology, which can only give rise to confusion in our descriptions of disease.

Abnormal position of the lens.—The 'suspensory ligament,' which is attached to the capsule all round the margin of the lens, maintains it in a fixed position. A blow on the eye sometimes ruptures a portion of this ligament, and allows the lens to become tilted backwards. If the ligament is detached to a considerable extent, the lens sways to and fro with every movement of the globe, and vision is much confused. Eventually, under such conditions, the lens becomes opaque; but I have seen cases in which it remained transparent for a very considerable time.

It appears that the suspensory ligament is liable to a congenital defect, whereby the lens, instead of maintaining its normal position, undergoes displacement in a lateral direction, so that its centre no longer coincides with the centre of the pupil. A curious instance of this malposition of the lens occurred in a mother and three children who came under my care. In the mother, and in one of the sons, both lenses were displaced upwards and inwards; in another son, directly inwards; and in the third, directly upwards. In none of these cases did the lenses deviate, or only in the slightest possible degree, from their normal transparency.*

CATARACT.

This term, as I have already observed, should be strictly limited to denote partial or complete opacity of the lens.

The existence of capsular cataract has of late years been called in question, and I shall presently notice the grounds of this new opinion.

Opacities of the lens do not appear to be all of precisely the same nature. Some depend upon a shrinking and wasting of the fibres themselves, without any appreciable change in their chemical composition, while the more strongly-marked and chalky-looking streaks and spots are formed by new deposits of earthy and fatty material.

We shall best appreciate the changes which take place in cataract by glancing at the anatomy of the lens. It is completely enclosed within the very thin, but strong, capsule, which is throughout perfectly transparent and homogeneous. To this capsule is attached the 'suspensory ligament of the lens,' which passes off from the back of the ciliary processes to be implanted into the capsule of the lens, with which it becomes identified. Immediately within the capsule is a layer of cells; internally to this layer are arranged the superficial fibres of the lens, softer and of a more fragile consistence than those forming the centre or *nucleus*. The fibres of the lens are disposed in planes, the exact arrangement of which cannot easily be understood without the aid of diagrams; it may suffice for our purpose, however, to state, in general terms, that the fibres form radii converging from the circumference to the centre, and are more curved as they are nearer to the anterior and posterior surfaces of the lens, and less curved as they approach its vertical plane.

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* See a description of these cases in *Ophthalmic Hospital Reports*, vol. i. p. 54, 1858: also in my *Guide to the Practical Study of Diseases of the Eye*, 2nd edit. p. 401.

Such being the manner in which the elements of the lens are arranged, we shall at once perceive the reason why the opacities of cataract present such different appearances, accordingly as they are in the superficial cellular, or the deeper fibrous layers.

When the superficial cells and adjacent soft fibres of the lens become disintegrated and broken up, and intermixed with generally diffused earthy deposits, the whole area of the pupil presents a milky appearance, without any regular striæ being visible. If the softening process has been going on for a long time, there is usually an abundant formation of fatty matter, and the faintly-bluish skim-milk colour gives place to a slightly yellow tint, like that of cream.

If, however, the cataractous opacity commences in the unbroken fibres of the lens forming its cortical portion, whitish streaks are seen converging from the circumference towards the centre. In persons past middle life some of these streaks have a slightly-yellow cast, while others are perfectly white. This difference of tint depends upon the fact I have already noticed, namely, that the body of the lens, after the age of thirty or forty, acquires a yellow tinge; and consequently, although the opaque streaks are in themselves white, only those appear so which are on the anterior face of the lens, and are viewed through the colourless media of the cornea and aqueous humour; while, on the contrary, the streaks on the posterior face of the lens, being seen through its still transparent, although yellowish, body, acquire a corresponding change of colour. A practised eye will also recognise a difference of form between these two sets of striæ; those on the front of the lens presenting a convexity, and those on the hinder face a concavity, towards the plane of the iris.

These striæ can be clearly seen only in the earlier stages of cataract, for eventually the superficial fibres and cells become broken up and disintegrated, and then the lens presents one uniform whitish or greyish surface.

The fibres of which the *nucleus* consists are denser and firmer than those constituting the cortical portion; but they are disposed in the same radiating form. When this nucleus becomes opaque in old age, it does not present the marked striæ so characteristic of *cortical* cataract, but assumes a more uniformly cloudy appearance. The distinction between the *cortical* and the *nuclear* portions of the lens are best seen in the common form of congenital cataract, in which the whole nucleus is opaque, while the periphery remains almost or quite transparent.

I have briefly alluded to the doubts which some histologists have thrown upon the existence of 'capsular cataract'—a term employed even quite recently as designating one of the two grand divisions of cataractous opacities. These doubts chiefly originated with Stellwag,* who, after carefully examining with the microscope about fifty cataracts with apparently opaque capsules, asserted that in every instance the opacity was caused by substances *attached to* the lenticular surface of the capsules, but not *deposited in* the very tissue of the capsules themselves. The opaque material which, to the naked eye, seemed identified with their tissue, chiefly consisted of earthy and fatty deposits, firmly adherent to it, but yet separable by mechanical or chemical means.

The marbled and mottled appearance commonly described as characterising 'capsulo-lenticular cataract' is said by Stellwag to depend upon the irregular manner in which the earthy and fatty material is deposited on the inner surface of the capsule.

Although the facts pointed out by Stellwag and others may justify us in discarding the term 'capsular' as designating a species of cataract, it would be affectedly precise to abandon the term *opaque* as applied to a portion of capsule impeding vision, merely because the opacity may be due to earthy or fatty matter adhering to the membrane. And, indeed, a portion of capsule which is transparent and invisible when perfectly tense, will become opaque when relaxed and thrown into folds.

Reverting to the changes in the lens itself, I would observe that a very common error exists with regard to the use of the terms *hard* and *soft* as applied to cataract. These terms are employed as if, in certain cases a softening process set in from the very first, whilst in other cases the reverse took place, and the whole lens underwent a steady process of hardening. But if we examine a healthy lens at the infant period of life, and compare it with one which is congenitally opaque, we shall find but little difference in the consistency of the two structures.

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* *Die Ophthalmologie,* 1853–58.

In the adult, the lens retains nearly its normal consistency so long as the opacity remains at the striated stage, and it is not until after a considerable period that the superficial portion of the lens undergoes that process of disintegration which imparts to it the uniformly whitish and milky appearance.

Again, in old subjects the commencement of cataract is not attended with any marked hardening of the lens, although, as the nucleus becomes opaque, its fibres appear to undergo a certain process of drying and atrophy. But even in the oldest persons superficial softening eventually sets in, usually many years after the first commencement of opaque striæ.

Hence it will appear that the terms *hard* and *soft* express only a certain stage in the progress of a cataract; that in no form of the disease does the lens from the very beginning undergo progressive hardening; but those lenses which for a long time retain their normal firmness while opacity is advancing, eventually become softened, and may even, in the lapse of many years, undergo a complete transformation into a fluid condition.

Under the two heads, *Nuclear* and *Cortical*, we may arrange all the various forms of cataract; abolishing the old term 'capsular cataract,' and assigning those opacities which were formerly known by that name to the *cortical* division.

Nuclear cataract would comprise, first, the congenital form of the disease; and, secondly, that which is met with in old age, either alone, or, more frequently, associated with marginal striæ.

Cortical cataract is by far the more usual form; for the opacity which occurs in middle life almost invariably commences in the cortical portion of the lens; and even in old age this is the rule, the rare exception being that the nucleus becomes cloudy before marginal striæ are developed.

It was owing to insufficient exploration of the eye that the reverse of this was formerly believed to be the case; but no one can have had extensive opportunities of examining the eyes of old persons under the influence of atropine, without convincing himself that, even in extreme old age, it is much more common to find marginal opacity beginning whilst the nucleus is still clear, than to find nuclear opacity beginning while the margin of the lens is transparent.

Diagnosis of cataract.—There is no better test of an ophthalmic surgeon's skill than his ability to determine the presence or absence of opacity in the lens. And nothing is more important to be precisely ascertained; for the want of skill to detect cataract in an early stage may lead the surgeon to regard the case as one of retinal defect; or, on the other hand, he may mistake the reflex of light from the retina for the opacity of cataract.

I will not detain the reader with a long account of the *subjective* symptoms which attend cataract; for the detection of the disease depends wholly upon a careful examination of parts lying open to our observation. A full detail of subjective symptoms is, no doubt, very useful in ascertaining the morbid condition of a structure wholly concealed from our view; but this is not the case with the lens, and if we suspect opacity to exist, we have simply to look for it.

A more or less marked dimness of sight, uniformly involving the field of vision—coming on gradually, and without inflammation, unattended with any impairment of motory power in the iris—such would be the symptoms which would make us suspect the existence of cataract. Our examination should be conducted in the following way:

The patient should be placed close to a window admitting bright daylight—not direct sunlight—and care should be taken that the light does not fall upon the cornea from more than one window, and that reflections from mirrors and other polished surfaces do not interfere with the single ray which should pass into the pupil. A convex glass of an inch focus should be used as a condenser, to concentrate light upon the surface of the patient's lens, while we explore it with the naked eye. In this manner faint streaks of opacity may be detected, which would otherwise escape us. Each eye must be separately examined.

We must never rest satisfied with a patient's assurance that he can or cannot read, but must obtain a precise standard of his sight by making him read aloud from type of different sizes.

In hospital practice, those who have not learnt their letters may be told to count dots, point out a single and a double line, an asterisk, and other typographical marks.

All these experiments must be made while the eye is in its natural state. We next proceed to dilate the pupil with atropine. A solution of two grains to the ounce of distilled water is usually strong enough for this purpose, and care should be taken to obtain the sulphate perfectly neutral. Any excess of acid makes the application painful, and so of course does the addition of alcohol, which I have sometimes seen prescribed. The lower lid should be slightly drawn away from the globe, and a few drops of the solution let fall between them ; and then the lids should be kept closed for a quarter of an hour or half an hour. Children, and even timid adults, are often alarmed at the sight of any bottle of drops, so instinctively do they suspect that all drops necessarily cause pain. A disk of atropised gelatine may be quietly slipped on to the conjunctival surface of the lower lid, without the patient being aware that any such application has been made.

When the pupil is fully dilated, we repeat our examination as before, with the aid of concentrated daylight, carefully illuminating and exploring the extreme margin of the lens, and, if its body be sufficiently transparent, lighting up and examining its posterior surface. In this manner the faintest streaks of commencing cataract may usually be detected ; while dense patches along the margin of the lens, opaque striæ converging along its anterior or posterior surface, delicate lines radiating from the centre, or the uniform haze of a cloudy nucleus, can hardly escape detection.

While cataract is still in a very early stage of development, it is so important to ascertain the condition of the retina and choroid, that in every case the ophthalmoscope should be used to complete our diagnosis.

By examining the deep tissues we sometimes detect in them morbid conditions, which would induce us eventually, when cataract had become complete, to abstain from operating ; or, if an operation were deemed desirable, it would be undertaken on the full understanding that only partial success would be attainable.

Reasoning *à priori*, we should imagine that the ophthalmoscope would be an infallible means of detecting those faint traces of cataractous opacity which elude the ordinary modes of observation ; but experience shows us that, under the strong glare of the ophthalmoscope, these faint opacities frequently disappear, just as a slight flaw in a piece of glass might become visible when laid upon a black surface, although it would not be seen when the glass was held in front of a brilliant light.

In most cases, however, the opaque striæ of a commencing cataract are seen under the ophthalmoscope as radiating black lines, while a hazy nucleus assumes the appearance of a dark cloud in the centre of the pupil.

Sometimes the very earliest commencement of cataract may be detected by examining the lens with the naked eye in a darkened room, while a strong light is thrown upon the part either from the ophthalmoscopic mirror, or by means of a convex glass of a short focus. This oblique illumination will often reveal highly-refractive globules and radiating lines throughout the whole extent of a lens, which to ordinary ophthalmoscopic examination seemed transparent.

I have already spoken of the twofold division of cataractous opacities into cortical and nuclear, accordingly as they are situated in the periphery or the centre of the lens. To give any special names to cataracts, in consequence of the various shapes which the opaque deposits assume, appears to be altogether trifling and useless. It is evident that the transparent and opaque elements of a diseased lens may arrange themselves in such a manner as to produce infinite variations of shades and figures, without offering any real variety in their composition. There are, however, a few leading peculiarities connected with age and mode of development, which demand a separate notice.

CONGENITAL CATARACT.

This opacity may exist in very different degrees.

1. The slightest form is that of a small white central dot on the anterior face of the lens (*Cataracta centralis*). This dot consists of a minute portion of earthy matter deposited in the most superficial portion of the lens, just within the capsule. In cases of this kind the rest of the lens commonly remains throughout life transparent, and the patient is often unconscious of any defect of vision. Occasionally, however, a few faint white lines are seen radiating from the central dot. If the rest of the lens remains transparent, this slight form of cataract should by no means be treated by operation.

2. Sometimes, instead of forming a minute central dot, the earthy deposit is so large as to occupy nearly the whole area of the pupil, when in its contracted state. The deposit projects forwards in the shape of an obtuse white cone, and appears to adhere by its base to the anterior surface of the capsule. This, however, is not really the case, the cretaceous mass being embedded in the superficial portion of the lens, and covered by the transparent capsule. The term *Cataracta pyramidata* has been given to this congenital form.

3. The most common kind of congenital cataract is that in which the nucleus is opaque, while the peripheral portion remains transparent. In the contracted condition of the pupil this transparent portion is hidden by the iris, but it comes into view when the pupil is widely dilated. In the contracted, or but slightly dilated, state of the pupil, its entire area is occupied by a greyish-white opacity, made up of fine radiating lines, which converge to an opaque white patch at the centre of the lens. When the pupil is widely dilated with atropine, this opacity is seen to be surrounded by a perfectly black area, and through this clear ring-shaped space the patient has tolerably clear vision. Those who examine such cases for the first time are apt to imagine that the opaque nucleus which they see really constitutes the whole lens, shrunken and contracted to an unnaturally small size, and that the dark ring-shaped space is altogether unoccupied by lens-tissue. Occasionally a few white lines are seen to traverse this space, passing from the opaque nucleus to the outer margin of the lens. When such a nuclear cataract is broken up with the needle, in the operation for solution, the real nature of the case is made manifest, and the peripheral portion of the lens soon becomes as opaque as the nucleus itself.

If cases of this kind are not operated upon in early life, the patients, although very short-sighted, continue for many years to enjoy considerable powers of vision; but usually, towards the age of forty, if not sooner, the peripheral portion of the lens undergoes a change, and gradually becomes opaque.

4. A form of congenital cataract, much more rare than that just described, consists of a very faintly-striated opacity of the nucleus, unaccompanied by that chalky-white central patch which renders the ordinary congenital cataract so conspicuous and so easy of diagnosis. Several instances have come under my notice, in which this rarer kind of cataract has remained undiscovered until the patients were of an age to be sent to school, when their inability to read ordinary type has caused their friends to seek advice.

5. It is very unusual to find cataract first commencing between infancy and puberty; but I have met with a few cases in which the opacity seemed to have begun when the patients were about nine or ten years old. They had been sent to school at the age of seven or eight, and had readily learned to read; but at the end of a year or two their sight began to fail, they

became at first short-sighted, and then gradually lost the power of reading any but large type, or of recognising faces across a room.

I have observed two distinct forms of opacity in these cases.

In one form the lens was dotted throughout with minute white points, arranged in the course of its fibres. These dots were as small as if pricked-in with the finest needle, and the general effect they produced was that of a very faint haziness in the pupil, only recognisable under concentrated light.

In a second set of cases the opacity was wholly confined to the posterior surface of the lens. In some instances there was one isolated patch in that situation, not exactly in the axis of the lens, but reaching from near that point to its extreme edge. In other cases the whole posterior face was covered with very fine opaque lines, closely set together, and converging from the circumference to the centre, so as to produce the effect of a delicate fibrous membrane of concave form. Encircling the exact centre of this opaque surface was a whitish ring, more dense and earthy in appearance than the rest of the striated surface of which it formed a part.

These opacities, limited to the posterior face of the lens, of course require for their detection far more careful observation than congenital cataract of the ordinary kind, in which the whole nucleus is opaque, and the centre probably marked with a chalky-white patch in the very centre of the pupil.

Congenital cataract, whatever form it may assume, is frequently accompanied by a rhythmical twitching movement of the eyeballs, the effect of irregular action either of the recti or the oblique muscles. This twitching is known by the name of *nystagmus.* It does not, however, invariably accompany congenital cataract, some patients suffering from this affection being entirely free from any irregular muscular action: while, on the other hand, *nystagmus* is met with in many cases of defective sight wholly unattended by any opacity of the lens.

There are certain morbid deposits in the deep tissues of the eyeball which in infants and children may be mistaken for the opacity of cataract. Scrofulous and encephaloid deposit, for instance, in their early stage, are not unfrequently mistaken in this manner; but a careful examination through a well-dilated pupil, cannot fail to detect the real nature of the disease. Both scrofulous and encephaloid deposits have a more or less yellow colour, and by a practised observer will be recognised as lying much farther back than the hinder surface of the lens. At a certain stage, however, of scrofulous and encephaloid deposit the lens becomes cloudy; and how, it may be asked, is a secondary cataract of this kind to be distinguished from one which is primary, and unconnected with any other affection of the globe? In an eye affected with simple cataract the position of the iris is usually vertical, or nearly so; the pupil is active; the lenticular opacity is regularly striated, and perhaps exhibits also at its centre a white dot. In advanced scrofulous and encephaloid disease, on the contrary, the anterior chamber is obliterated, the pupil is irregular, dilated, and fixed; the lens has an uniformly cloudy appearance, and sometimes receives from the mass behind it a somewhat yellowish tint. Congenital cataract, too, almost invariably affects both eyes; while encephaloid deposit almost as invariably occurs in one eye only. Scrofulous deposit does, indeed, occasionally affect both, but rarely to the same extent, or at the same time.

In children and also in older persons who have been brought under my notice for congenital cataract, I have been struck with the frequent occurrence of diseased teeth; the incisors and canines being dwarfed, deficient in enamel, discoloured and honey-combed on their anterior surface, and their cutting edge worn away and blunt. I am unable to offer any explanation of this condition of the teeth, which I do not find mentioned by any ophthalmic observer.

CATARACT IN ADULTS.

Except as a result of injury, cataract is rarely seen to commence between puberty and the middle period of life. Up to the age of forty it is a rare disease, it becomes more common in patients who have passed their fortieth year, but it is after the age of fifty or sixty that we are more especially on the watch for it in patients complaining of failing sight.

Even up to extreme old age cataract usually commences at the circumference of the lens, in the form of opaque striæ, which gradually advance along the anterior and posterior faces of the lens towards its axis.

About the same time very fine whitish lines may be observed to radiate from the anterior pole of the lens, marking the divisions which exist between the planes in which its fibres are arranged. After the age of sixty a hazy condition of the nucleus is commonly found co-existing with advanced marginal opacity; but even in extreme old age it is far more common, as I have already observed, for cataract to commence at the margin than at the nucleus.

If we trace the rise and progress of cataract in an elderly person, the changes will usually be found to occur in the following order. First, opaque striæ are formed at the extreme edge of the lens, and commonly it is the lower edge which is thus affected. These striæ gradually coalesce into patches, and then spread themselves over the posterior face of the lens, only a few extending a short distance over the anterior face. At this point of development the cataract may remain stationary for a year, or even for several years. Then a farther change takes place, and the whole body of the lens, but especially the nucleus, becomes slightly hazy, but not so as to prevent the posterior radiated opacity from being recognised when properly illuminated. The opaque striæ on the anterior face of the lens gradually advance until their tips appear within the area of the pupil. The haziness of the body of the lens increases until even concentrated light fails to reveal the posterior striæ, and at last only the anterior surface of the lens can be seen. At this stage of cataract, vision is restricted to mere perception of direct light, or of that reflected from white or polished surfaces. Perhaps bright colours may still be recognised.

Up to this point the fibrous structure of the lens can still be traced; but as years go on, its surface becomes more opaque and whiter, in consequence of disintegration of the superficial fibres, and the deposit among them of earthy and fatty material. Occasionally crystals of cholesterine, just within the capsule, may be recognised by their peculiar sparkling appearance.

It sometimes happens that this final stage of superficial softening does not occur, and the cataract is then very difficult of detection, having a dull brownish appearance like horn.

A very rare form of lenticular opacity is that termed 'black cataract.' The name is frequently given to lenses which are only of a dark-brown colour, but absolute blackness is sometimes met with. It must not, however, be supposed that in these cases the blackness of the pupil is like that presented by a healthy eye, in which all the humours are perfectly clear. In the two or three cases of black cataract which I have seen, there was not the slightest doubt as to the existence of a cataract, although the blackness, so remarkable after extraction, was not suspected; for, in each instance, several fine whitish lines could be seen radiating on the anterior surface of the lens, formed, no doubt, by slight earthy deposits just within the capsule.

Fluid cataract; Morgagnian cataract.—The softening process, which begins in the superficial portion of an opaque lens, may go on until, in the course of years, the whole mass becomes converted into a thin pulp. The nucleus, for a long time, resists this softening change, and a lens consisting of a firm nucleus, surrounded by a turbid pulp of disintegrated tissue, has received the name of 'Morgagnian cataract.'*

As in fluid cataract all the superficial portion of the lens is disintegrated, there is of course no trace of those radiating striæ so characteristic of ordinary opacity. Sometimes a fluid cataract is bluish-white, like milk-and-water; in other cases it assumes a dirty-grey colour, or a pale-yellow tint, like that of cream. Its consistence appears unequal, as if some portions were coagulated, and others perfectly fluid.

The creamy colour is usually found in cataracts that have existed in the fluid state for a considerable time, and it seems rather paradoxical to assert that it is very difficult, even for a practised observer, to distinguish between a fluid lens of this kind and one which has undergone a change of a directly opposite character, and become solidified by earthy deposit. The perfectly fluid and the perfectly solid lens are equally devoid of fibrous markings, and the inequality of consistence in the former presents an appearance very similar to that resulting in the latter from the variety in tint, caused by the manner in which the earthy constituents of the solidified lens are deposited on the capsule.

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* This form of cataract was not described by the Italian anatomist from whose name the term is derived. In dissecting the eyes of animals he had observed a fluid to exude from between the capsule and the lens, and concluded that this fluid always existed during life. In compliment to the discoverer it was termed by anatomists *liquor Morgagni*, and its existence in the living eye was for a long time regarded as indisputable; subsequent observation, however, has proved it to be a product of *post-mortem* decomposition. Morgagni has been, as it were, quoted against himself; for, in treating of the causes of cataract, he suggests that the disease may originate in a deficiency of this very fluid, whereby the lens, he thinks, would become dry and opaque. His words are: 'Tunicâ in vitulis etiam, bobusque, sive recens sive non ita recens, perforatâ, pluries animadverti illico humorem quendam aqueum prodire: quod et in homine observare visus sum, atque adeo credidi *hujus humoris secretione prohibitâ*, crystallinum siccum et opacum fieri, fere ut in extracto exsiccatoque crystallino contingit.' (*Adversaria Anatomica,* &c., Lugd. Bat. 1741, Adv. vi. p. 90.)

The following are mentioned among the distinguishing signs of a fluid cataract—an advance of the iris towards the cornea, caused by an increase in the bulk of the lens, attending the fluid change—and a difference in the degree of opacity in the cataract, as respects its upper and lower portions, caused by the gravitation of its denser particles. But neither of these signs can be relied upon; for in cases of fluid cataract it often happens that the iris deviates little, if at all, from a vertical plane; and the separation of the contents of the capsule into fluid and solid is seldom sufficiently complete to allow of the more solid portions gravitating in the manner described by authors.

If a fluid cataract is examined with the microscope, the lens-fibres are found in every stage of disintegration, mixed up with earthy matter and a multitude of oil-globules.

TRAUMATIC CATARACT.

The lens may lose its transparency in consequence of a blow on the eye, although the globe may not be ruptured, or the lens itself displaced from its connections; the mere shock being sometimes sufficient to affect the nutrition of the lens, and induce a gradual opacity of its whole substance.

Any penetrating wound of the lens is sure to produce cataract, and if the wound in the capsule remains open, so as to allow the superficial cells and fibres of the lens to imbibe the aqueous humour, the whole mass gradually becomes disintegrated and absorbed, so that eventually a wounded lens may wholly disappear without any surgical interference. It was a knowledge of this natural process that first suggested the operation for the cure of cataract by *solution*. It is only in exceptional cases that the whole lens becomes absorbed in consequence of a wound. More commonly it happens that a certain portion of lens-tissue remains enclosed within the capsule, and undergoes fatty change. The following is the appearance such a traumatic cataract would present some years after the occurrence of the injury.

There is probably some adhesion of the pupillary margin to the capsule, the result of old iritis; the pupil is occupied by a disk, formed by the approximation of the anterior and posterior surfaces of the capsule, enclosing between them some remains of very opaque lens-tissue. This disk is situated much farther back than the position occupied by a full-sized lens, and its dead-white patchy area not unfrequently exhibits some glistening crystals of cholesterine.

In cases where the wound of the lens has been followed by a considerable amount of iritis, the whole margin of the pupil may be found adherent to the anterior capsule, which may also be coated with a dense membrane, composed of old lymph. The pupillary area may be small, and not susceptible of increase by the use of atropine, on account of the intimate union between the iris and the capsule. Occasionally there is a deceptive appearance of a partial opening of the pupil, and a casual or inexperienced observer will suppose that a sufficient portion of the pupil is free, so as to allow of useful vision. The supposed aperture, however, is really a patch of black pigment, lying on the whitish membrane which is closing up the pupil. Light, concentrated on the part by means of a lens, will almost always reveal the true nature of the supposed aperture, or, should this means fail, the ophthalmoscope will at once resolve the doubt.

It would be impossible to describe all the various appearances presented by the pupil after the partial or complete absorption of a wounded lens. The capsule may block up the entire space in the manner just described; it may form a delicate filmy network, hardly visible except under concentrated light; it may have been completely torn through at its centre, the peripheral portion retracting all round, so as to form a white ring, almost hidden by the iris; or it may assume the appearance of a single white band stretched across the pupil from side to side. In short, there is hardly any possible variety of figure which the opaque capsule may not assume.

It never undergoes absorption, but it often appears to do so, in consequence of the manner in which it retracts and shrinks together when divided. This retractile property of the capsule should always be borne in mind by the surgeon, in the various delicate operations which become necessary when an opaque portion of it is obstructing the pupil. He should take care not to isolate any part of the opaque membrane, but to regulate his incisions and lacerations of it in such a manner that it may always have a fixed point at the periphery, towards which it may retract, and so leave the central portion of the pupil free.

Dislocation of the lens into the anterior chamber.—This accident takes place as a result of external violence, such as a blow upon the eyeball or a violent fall. It more frequently happens when the lens has been long in an opaque condition, and its suspensory ligament weakened, or partially detached by disease. The appearance of an opaque lens in the anterior chamber is so peculiar, that the nature of the accident can hardly be mistaken. When the lens is dislocated in a transparent state, its margin presents the appearance of a ring of golden light. Pain and inflammation set in very soon after the occurrence of the accident, and loss of the eye can be averted only by prompt removal of the lens, through a suitable opening in the cornea.

I have already spoken of certain forms of partial displacement of the lens, when treating of the inflammation such accidents give rise to (see the section, 'Traumatic Iritis,' p. 98); and have considered 'subconjunctival dislocation of the lens' in the chapter on Affections of the Sclerotic (p. 90).

TREATMENT OF CATARACT.

Before describing the treatment of cataract, I may be expected to say something respecting the morbid agencies which give origin to it. But, in truth, the causes of cataract, whether remote or proximate, have hitherto received no satisfactory explanation. The fact that the lens may be opaque at birth, or may become so in old age, at once proves under what widely different conditions the disease is developed; and we need but cast a glance at the varying and even opposite theories which have been given as to the predisposing causes of cataract, to convince ourselves they are but guesses, for the most part fanciful and unfounded.

Thus, one author thinks that persons exposed to the heat and glare of strong fires are predisposed to cataract; another makes the same remark of those who drink sour wines; by a third, the prevalence of cataract among the Turks is attributed to their using opium; while other observers consider that the inhabitants of volcanic countries are peculiarly liable to the disease. Certainly, in its senile form, cataract is common enough among our own agricultural labourers, who know nothing of sour wine, and very little of opium, are not incommoded by over-large fires, and never saw a volcano.

The truth seems to be, that, in all countries, cataract is a frequent accompaniment of advancing years; and neither social position nor peculiarity of employment exempts the aged from being liable to it.

Can cataract be cured without an operation? This question will be answered in the affirmative by hosts of quacks, who, for their own selfish ends, avail themselves of that shrinking from anything bearing the name of an operation, which is a natural instinct in us all, and pretend, by means of liniments, or drops, or the still more scientific-looking galvanic battery, to turn opaque lenses into clear ones.

It would be presumptuous and absurd to pronounce absolutely that no cure for cataract, short of a surgical operation, can *ever* become possible. But certainly nothing approaching to such a cure has hitherto been discovered.

The surgeon must constantly be on his guard against being too much impressed with the mere existence of opacity in the lens, as if it were altogether an independent disease.

Various inflammatory conditions of the eyeball may eventually produce cataract, but in such cases there are usually some signs of disease in other tissues, as well as certain peculiarities in the position or appearance of the lens itself. Old adhesions between the pupillary margin and the anterior capsule—a bulging forward against the cornea of the iris and lens, or their receding too far backwards, so as to produce an unnaturally large anterior chamber—an irregularly dilated and fixed pupil—a tremulousness of the lens whenever the recti muscles are put in action—total loss of perception of light—such are the more striking conditions which at once would lead us to institute searching inquiries into the earlier history of the case, or to regard the cataract as unsuited for operation.

It must always be remembered that simple opacity of the lens, however far advanced, never deprives a patient of perception of light, provided the retina is sound. Indeed, in the great majority of instances, a patient with no other disease in the eye but an opaque lens, will not only readily perceive the shadow of a hand, or other object, passing between him and the sky, but, with his back to the window, will perceive the light reflected from a sheet of paper, although he may be quite unable to detect the form of the reflecting surface. Many patients, with densely opaque lenses, will, in the same position, recognise well-illuminated coloured surfaces, such as bright red or yellow, or will even discriminate between yellow and white. If, in addition to this perceptive power, the iris maintains its vertical plane, the pupil is round and active, the cornea brilliant, the consistency and movements of the globe perfect, the surgeon may regard the cataract as suitable for operative treatment.

Long experience and observation will give to the surgeon a certain empirical tact in determining whether a given case of cataract is, or is not, fitted for operation. He recognises at once the difference between an eye which has passed through inflammatory stages, and one in which simple opacity of the lens is present. In the latter case, however dense the cataract may be, the patient has a certain expression of *trying to see*, quite different from the manner of one who merely turns his eyes this way or that, at the command of the surgeon.

In all cases the pupil should be dilated with atropine before the surgeon finally resolves to operate, so that no concealed adhesion between the iris and the capsule may remain undetected.

OPERATIONS FOR CATARACT.

These may be arranged under three heads: *depression*, *solution*, and *extraction*.

1. In *depression*, or 'couching,' as it was formerly termed, the lens is thrust from its natural position in such a manner that, although still within the eye, it may allow the rays of light to pass unimpeded through the pupil to the retina.

2. The operation by *solution* or *absorption* grew out of that by depression; for it was found that if, in the attempt to depress the lens, it accidentally became much broken up, the fragments gradually dissolved and disappeared; and hence it occurred to certain thoughtful observers that this absorbent power in the system might be taken advantage of in such a manner as to avoid the dangers inseparable from the old operation of 'couching.' Hence arose *discission* or *division* of the lens, since modified into the operation by 'solution.'

3. In *extraction* the opaque lens is removed bodily out of the eye, through a wound made for that purpose in the cornea.

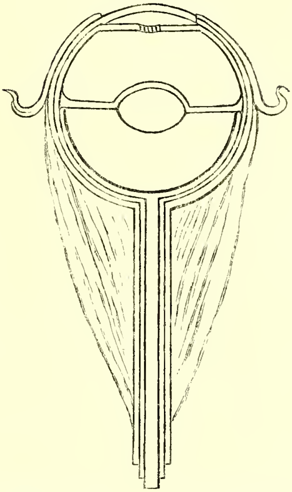
OPERATIONS BY DISPLACEMENT OF THE LENS.

(*Depression*; *Reclination*.)

Those who are interested in the early history of ophthalmic surgery will find the older descriptions of cataract, and the operation for its cure, wholly unintelligible, unless they are acquainted with the views of the ancients respecting the anatomy of the eye.

Even so late as the time of Vesalius it was believed that the lens occupied the exact centre of the globe, and it is so figured in that anatomist's work, *De Corporis Humani Fabricâ*, 1555, p. 798, where it is placed exactly midway between the iris and the junction of the optic nerve with the retina; the posterior chamber of the aqueous humour and the chamber of the vitreous humour being precisely of the same extent. Such a position of the parts would of course afford ample space for an opaque *humour* to collect, and form the supposed 'cataract' between the lens and the iris.

FIG. 146.



Section of the eye as figured by Vesalius.

It is a curious fact that, while the operation of 'couching,' or depression, had been practised from very early times, each successive generation of surgeons firmly maintained that what they depressed was not the lens—which, indeed, they believed to be the immediate seat of vision—but a skin, or coagulated film, in front of it. Ambroise Paré, the most celebrated surgeon of his day, after describing the mode of introducing the needle through the sclerotic, and depressing the cataract, adds, 'en faisant telle chose se faut bien donner garde de toucher à l'humeur cristalin, pource que, comme nous avons dit, il est le principal instrument de la veüe.' *

It was not until the latter part of the seventeenth century that the real nature of cataract was understood; and some of the old oculists, who had passed their lives in depressing lenses without knowing it, were furious at the new-fangled theory of cataract being the opaque lens itself.†

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* *La Méthode curative des Playes*, &c. Paris, 1561.

† Thus Woolhouse, an oculist who, in spite of his gross ignorance, was the leading operator of his day, was most indignant when Brisseau, appealing, in proof of his assertion, to dissections of cataractous eyes, declared the lens to be the seat of cataract. Facts were against Woolhouse;—'tant pis pour les faits!'

The early surgeons, therefore, who, from time immemorial, had taught the operation of depression, however they may have erred in *practice*, through their ignorance of the real pathology of cataract, acted in perfect accordance with their own *theory* of its nature; for such a membrane as they believed a cataract to be, when once thrust fairly away from the pupil, would not have been likely to set up irritation. One can less readily understand how, after the real nature of cataract had become known, operators could still imitate the old manipulations, and persuade themselves that so bulky a body as the lens could be displaced in such a manner that it should not press upon, or interfere with, any of the delicate tissues surrounding it.

To pass a needle through the sclerotic, until its point arrived at the upper edge, or the front surface of the opaque lens, which was then thrust downwards, or backwards and downwards, and embedded in the vitreous humour, appeared a real triumph of surgical skill; so instantaneous was the benefit conferred by the operation, and so trifling the pain of its performance. The patient was in a moment restored to sight, and the smallness of the wound seemed to obviate all risk of inflammation. And, no doubt, depression, or the modified form of it, termed reclination, in which the lens is turned over on its posterior face, instead of being thrust vertically downwards, would be a very perfect operation, if it were possible to insure the lens being conducted to the position so neatly figured in diagrams, where it reposes in the vitreous humour, quite out of the way of the pupil, and close to, but never touching, the retina or ciliary processes.

But how is the lens to be so placed in reality? Even if the whole eyeball were as transparent as the cornea, so that the surgeon could keep the point of his needle in view throughout every stage of the operation, how could he deposit the lens precisely in the position I have mentioned? Or, if he succeeded in leaving it in the very spot he had intended, below the pupil, and yet above the retina, how could he insure its remaining there? how prevent its sinking downwards, so as to come in contact with the retina, or falling forwards against the ciliary processes and iris, where it must act as a foreign body, and set up irritation which nothing could subdue?

Depression, the oldest form of operation by displacement, was performed in the following manner. The patient was seated, and the surgeon sat facing him. An assistant, standing behind the patient, steadied the head and raised the upper lid. The needle being thrust through the sclerotic, a little below the equator of the eye, and a short distance from the edge of the cornea, was to be carried between the iris and lens, until the point of the instrument appeared in the area of the pupil. It was thrust on as far as the upper part of the lens, which was then pressed directly downwards, until it descended below the ordinary level of the pupil. It must be evident to any one familiar with the anatomy of the eye, that a body so large as the lens could not be made to descend vertically to any considerable extent, without coming in contact with the ciliary processes; but we must remember that the old oculists performed their operations without the aid of mydriatics, so that they could press the cataract out of sight without forcing it to descend so low as would be necessary to make it disappear from an artificially-dilated pupil. Still, there can be no doubt that they frequently thrust the opaque lens either against the ciliary processes or against the retina, and hence the 'inflammation,' which was looked upon as almost a natural consequence of the operation.

To obviate the danger consequent upon depressing the lens directly downwards, the operation of *reclination* was devised, whereby the lens was pressed in a direction backwards, downwards, and a little outwards. The needle was passed on until its lance-shaped head appeared in the area of the pupil, as in the operation of depression; but the flat of the instrument was placed on the anterior face of the lens, a little above its middle, and steadily pressed against it, until the lens was forced to quit its natural position, and sink down into the vitreous humour. Here it was to be left, with its anterior surface directed upwards, its posterior surface downwards; close to, but not touching, the retina; its lower edge towards, but not in contact with, the ciliary processes; a state of things often figured in diagrams, but rarely, I should think, effected in practice.

The close approximation of the pupillary margin to the anterior capsule of the lens must render it almost impossible to pass an instrument between the two structures without wounding either one or the other of them. In fact, the capsule is usually opened, and undergoes still farther rupture in the attempt to dislodge the lens. No doubt this accidental rupture of the capsule and lens would, in some degree, obviate the dangers of the operation, inasmuch as a lens thus partially broken up would have some chance of undergoing absorption, which would not take place if the lens, according to the idea of the operation, were displaced, still enclosed in its unbroken capsule.

If chronic change should have occurred in the suspensory ligament of the lens, the cataract enclosed in its unbroken capsule might sink at the first touch of the needle, especially if the vitreous humour had become unnaturally diffluent; but if no such changes should have taken place, the vitreous humour would offer great resistance to this reclination of the lens; and, accordingly, various plans were suggested for facilitating the reclination by certain preliminary manœuvres. It was proposed, for instance, as soon as the needle had pierced the coats of the eyeball and entered the vitreous chamber, to carry the point to the back of the lens, for the purpose of lacerating the posterior capsule; then the point was to be carried round to the anterior capsule, which was to be lacerated in a similar manner, and it was not till after this preparation that the surgeon was to displace the lens itself.

Other operators, finding that the elasticity of the healthy vitreous humour was an obstacle to the passage of the lens through it, suggested that the needle should first be passed to the spot where the lens was finally to be lodged, and that a bed should there be prepared for it by the disintegration and breaking-up of the cells of the vitreous humour; and to this bed the lens was finally to be conducted by the needle applied to its anterior surface.

Descriptions of all these manœuvres read very well; but to carry them into effect is a very different matter. It must be remembered that while the point of the needle is lacerating the posterior capsule, or making a soft place in the vitreous to receive the lens, the instrument is wholly concealed from the surgeon's view, and is within a few lines of the most delicate and important structures. What risk must there not be that, while endeavouring to break up the cells of the vitreous, or lacerate the capsule of the lens, the surgeon may all the while be tearing up the ciliary processes, or even the retina itself!

To evade the difficulty of displacing a cataract by mere pressure with the flat of the needle, some operators proposed that, instead of carrying the instrument between the iris and the anterior capsule, its point should be thrust fairly into the substance of the lens, which would then be easily displaced, and carried downwards and outwards into the vitreous humour; the needle being disengaged by rotating it. Two difficulties, however, must attend this operation—the risk of driving the lens before the instrument in the attempt at transfixion, and of pressing the lens against the retina in endeavouring to disengage the point of the needle.

But even supposing that the surgeon succeeds perfectly in accomplishing the object he has proposed to himself, and, by depression or reclination, modified by any of the methods I have described, has displaced the cataract from the axis of vision, and sunk it in the vitreous humour, without inflicting injury either on the ciliary processes or the retina—what has he done? He has deposited a large foreign body—for as such we must regard a cataractous lens detached from its organic connections—in close proximity to the retina. How can he insure the foreign body's remaining suspended in the vitreous humour, without coming in contact with surrounding parts? Will not the vitreous cells in the immediate neighbourhood of the cataract undergo gradual disintegration, and allow it to come into contact with the retina, or fall forwards against the iris?

No doubt these would have been the almost invariable results of depression and reclination, were it not that, in the attempts to displace the lens, it very commonly became a good deal broken up; and this very accident it was which predisposed the lens, after it had been displaced, to undergo absorption. The ultimate issue, however, of most operations of displacement was sufficiently bad to justify my assertion, that it is essentially an unscientific and rough proceeding, calculated to set up a chronic state of inflammation in the deep tissues of the eye, which is in its very nature uncontrollable, inasmuch as the exciting cause, the displaced lens itself, cannot be removed.

Inexperienced persons who witnessed an operation of displacement were apt to admire the rapidity and apparent ease with which it was performed, and the immediate restoration of sight which took place; and they contrasted it, perhaps, with the extensive wound made in extraction, the accidents that occasionally attended that operation, and the slow after-progress towards useful vision. But these appearances were deceptive; every bystander could see the difficulties and mishaps that attended extraction, but in depression or reclination, if only the cataract disappeared from the pupil, everything seemed to have succeeded. The damage inflicted on deep-seated parts could not be detected, and it was only in following up the case that their result became appreciated, in the slow and insidious changes within the globe, which, many months after the operation, terminated in utter loss of sight. In such cases it was said how well the operation succeeded—how perfectly the patient saw, till, unfortunately, inflammation set in, and, in spite of everything being done that medical skill could suggest, destroyed the sight. And why did 'inflammation set in'? Either because structures essential to vision had been injured by some stab in the dark during the operation, or because a foreign body had been left in contact with them, to set up in due time an uncontrollable process of disorganisation.

OPERATION BY SOLUTION OR ABSORPTION.

I have said that this operation grew out of that by depression; and it is only surprising that some of the older surgeons, who had been struck by the manner in which fragments of the lens, accidentally detached during their attempts at depression, became spontaneously absorbed, did not discover that this law of absorption might be applied to the removal of the whole lens.*

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* Thus Pott, writing in 1775 on the subject of depression, says: 'When the opaque crystalline is in a state of dissolution, or the cataract is what is called perfectly soft, if the capsula of it be freely wounded by the couching-needle, the contents will immediately issue forth, and mixing with the aqueous humour will render it more or less turbid; sometimes so much so as to conceal the point of the needle and the iris of the eye from the operator. . . . . The aqueous humour, however turbid it may become, will in a very short space of time be again perfectly clear; and if no disorder of the capsula of the crystalline, previous or consequential, prevents, the rays of light will pass without obstruction through the pupil, and the patient will be restored to as perfect vision as could have followed the most successful operation of either, or of any kind, in the same subject and under the same circumstances.' He adds: 'I have sometimes, when I have found the cataract to be of the mixed kind, not attempted depression, but have contented myself with a free laceration of the capsula; and having turned the needle round and round between my finger and thumb, within the body of the crystalline, have left all the parts in their natural situation; in which cases, I have hardly ever known them to fail of dissolving so entirely as not to leave the smallest vestige of a cataract.' (*Chirurgical Observations*, &c. 8vo. 1775.)

Pott's merit did not consist in being the first to observe that soft cataracts, if broken up, would wholly dissolve, but in turning an accident into a ground for a special and definite operation; thus establishing solution as a legitimate method of removing an opaque lens. Peter Kennedy, in his anonymous *Ophthalmographia*, 1713, relates how, having depressed a cataract in a woman aged twenty, he endeavoured a year later to do the same with the other cataract, which was of the 'curdly kind.' He adds: 'I had no sooner touched

When this law began to be understood, surgeons fell into the mistake of supposing that the more completely the lens was broken up at first, the quicker would absorption go on; and they therefore endeavoured to cut up the whole lens into fragments, by what was termed the operation of *discission.*

The cure of cataract by solution is one of the most perfect and beautiful within the range of surgery. It is based on the law, already alluded to, that if the capsule be lacerated so as to expose the tissue of the lens itself to the macerating influence of the aqueous humour, the cells and fibres of the lens, by gradually imbibing this fluid, become broken up and dissolved; and are then so completely absorbed, that at the end of a period varying in duration according to the consistence of the lens and the absorbent power of the patient, every vestige of cataract will have disappeared. In fact, provided the patient's constitution be vigorous, and the lens be not too freely broken up at any one time, it is quite possible to effect the absorption of a cataract in an old person, even up to the age of seventy. But, inasmuch as in such persons cataract usually advances simultaneously in both eyes, the slow process of absorption is found to be wearisome and inconvenient, and liable to be interrupted by slight inflammatory attacks; and as the operation requires to be frequently repeated, the more rapid cure by extraction is to be preferred.

The leading principle to be observed in all operations for the solution of a cataract, is, not to oppress the eye with more broken-up lens-tissue than the absorbing power of the organ is capable of rapidly removing. If this rule be neglected, the numerous fragments act as so many foreign bodies; inflammation is set

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it with the needle, when it broke, and mixed with the aqueous humour, which becoming *drumly*, the patient could no longer see; I then withdrew the needle, and began to doubt of the success, but I found in a month's time all settled to the bottom, and her sight became clear and well.

But similar cures by solution had been quite unintentionally performed nearly two centuries before the time of Kennedy; as the real seat of cataract, however, was at that period unknown, these accidental cures by solution led to no further improvement.

I have not seen quoted on this subject the following remarkable passage from Ambroise Paré:—'Aucunes cataractes en les voulant abatre deviennent comme lait ou eau trouble, à raison qu'elles ne sont encore assez dures; et que telle chose advienne encore y a il esperance de guarison, pour ce que puis apres elle ne se peut rassembler, et apres quelque temps l'œil se clarifie, principalement aux jeunes.'—*La méthode curative des Playes*, &c. Paris, 1561, p. 239.

up in the iris and cornea, and then all absorption is at once arrested. The conjunctiva and sclerotic become injected; there is pain in and around the eyeball, with intolerance of light and lacrymation; the aqueous humour is turbid, and the epithelial surface of the cornea dull and uneven.

Operation on infants.—The breaking up of the lens, if carefully performed, is so devoid of danger that it should by no means be deferred on account of the tender age of the child; on the contrary, by operating early there is a greater probability of obviating those twitching movements of the globes (*nystagmus*), which so frequently attend congenital cataract. Of course, if the infant were extremely puny and ailing, affected with diarrhœa, or in any way weakened by temporary derangement of health, the operation should be deferred for a while, until the absorbent power had been restored; but it is desirable not to wait until the irritation of teething sets in.*

The needle I prefer for most of the operations on the lens has a small lance-shaped head, and the relative proportions of the head and the shaft of the instrument should be exactly such as will allow of the shaft playing with perfect freedom in the aperture which the head has made. If these proportions are not accurately preserved, and the shaft is made larger, with the view of preventing the escape of the aqueous humour, it becomes wedged in the wound, and all movements of the point are difficult and constrained. A needle of a larger size than that used for the ordinary operation on infants is very useful in breaking up the capsular obstructions which remain after the lens-tissue has become absorbed, as the head may be of such a size as to allow of its convex edges being made to cut.

All cataract operations are best performed on patients lying down. It was, I believe, at the Moorfields Hospital that this position was first adopted for all such operations, and it has since been introduced upon the Continent, where, a few years ago, patients always underwent the operation for cataract in a sitting posture. Infants are best secured by swathing them from the chin to the feet in a round-towel. An assistant steadies the head by placing a hand on each side of it; the lids are kept apart with a spring speculum, and sometimes it becomes necessary for a little fold of the conjunctiva, just beneath the cornea, to be nipped up in a forceps, so as to steady the eye. If the operator contents himself with using a single needle he can himself with the other hand use the forceps; but if he prefers a more complete laceration of the lens by the use of two needles at once, he must of course intrust the forceps to the hands of a second assistant.

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* The merit of Saunders seems to have been limited to establishing *as a rule* that congenital cataract should be operated on in early infancy. No doubt this rule is a most important one; but the extravagant praise on that account claimed for Saunders by his partial friends strikes one, at this distance of time, as quite disproportionate; and his practice of keeping the operation a secret, or at least of excluding medical men from witnessing it, would in the present day be reprobated as illiberal. One pupil, Adams (afterwards Sir William), was set apart, almost with the solemnity of a consecration, as the suffragan of Saunders, but of course the operation very soon became the common property of the profession.

And here I may observe, that the rule I have mentioned, as so important to bear in mind—namely, to avoid attempting too much at the first operation for solution, admits of an exception in the case of congenital cataract in *infants*. During the first few months of life the lens is so soft in texture—it so readily imbibes the aqueous humour, and undergoes dissolution, and the absorbent power is so active—that the lens may be freely torn up in every direction without the same risk of iritis and other inflammation, as would attend a similar disintegration of it in an older child or an adult. During the operation for solution on an infant I have frequently seen the entire lens shell out of its capsule, and slip forwards into the anterior chamber, without any inflammation taking place, the lacerated lens speedily undergoing complete absorption.

Previous to any needle-operations for cataract, the pupils should be dilated with a few drops of solution of atropine, applied an hour or so before.

The needle is to be introduced through the cornea * close to its junction with the sclerotic, and carried on until its point reaches the centre of the pupil. Then the anterior capsule is to be freely lacerated in various directions, and the body of the lens broken up, and the needle may be carefully passed quite through it, so as to lacerate the posterior capsule.

If two needles are used together, the first should be passed in until its point reaches the middle of the pupil, before the second one is introduced through the cornea.

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* I am assuming that all operations for solution of the lens, and for removal of capsule, are to be performed by *keratonyxis*. Formerly the needle was always passed through the sclerotic (*scleronyxis*); but the operation through the cornea, allowing, as it does, the point of the instrument being always kept in view, is evidently to be preferred.

In an infant with congenital cataract both eyes may be operated upon at once; but in an adult the worse eye, if there be any difference, should be operated on first, so as to leave the patient one partially useful eye, while the process of solution, with the temporary loss of sight which it involves, is going on.

After the operation both eyes should be kept closed by means of a light bandage, or strips of plaster on the eyelids, for twenty-four hours, by which time the little wounds in the cornea will have closed.

If the lens has been effectually broken up, and the infant is in good health, a few weeks will sometimes suffice to insure the absorption of the entire cataract; and the capsule, gradually retracting towards the periphery, will ultimately form a white ring almost or altogether concealed by the iris when the pupil is contracted.

But it is not always possible to effect this complete dispersion of the cataract by a single operation, and the capsule, enclosing between its layers a certain amount of unabsorbed lens-tissue, remains as a chalky-white disk, blocking up the pupil and preventing all useful sight. In such cases the two needles must again be employed, and the central portion of the opaque membrane torn through to the desired extent; or, in some cases, it may even be necessary to introduce the cannula-forceps through an opening made in the cornea, and extract the capsule entire. This latter proceeding, however, should never be resorted to if a good central opening can be effected by means of the needles only; for in spite of every precaution, the pupillary edge frequently becomes adherent to the wound made for the introduction of the forceps; or else the traction of the iris, to which the capsule often adheres, causes subsequent distortion and deformity of the pupil.

Operation on children and adults.—The cataracts which come before us in children, and in persons under thirty years of age, are very commonly those of the congenital form, which had been overlooked during the period of infancy. For it is rare to meet with instances in which cataract *begins* to be developed in childhood, or in the early years of adult life. The operation for the solution of cataracts of this kind is the same as that I have just described on the infant, with this important exception—that in the older subjects we must take care not to set up irritation in the eye by too extensively breaking up the lens at first; least of all must we be indifferent to the risk attending the accidental displacement of the lens into the anterior chamber, an occurrence which, as I have said, may happen in the infant without any bad results.

In the first operation on an adult, the surgeon should not do more than freely break up the anterior capsule to an extent equal to the area of the pupil when not under the forced dilatation of atropine, and disintegrate the superficial portion of the lens, without disturbing the nucleus. This may be done with a single needle, the spring speculum being used or not, according to circumstances. When aided by a skilful assistant, the surgeon may often dispense with the speculum; but it is usually more convenient to employ it, and its use will enable the surgeon to perform the operation alone, if no assistant is at hand.

In using the needle, the surgeon is always to begin to act with the point upon the central portion of the lens; and in all subsequent operations he is to work from the centre, endeavouring to effect an opening in this situation quite through the lens and posterior capsule, leaving a ring-like portion of both, to be dealt with, if necessary, by a final operation with two needles.

If, instead of beginning to attack the lens at the centre, the surgeon uses the needle at random, and breaks up the lens at the circumference, he will probably set loose some portions of capsule, which will afterwards wave to and fro in the pupil, and be a most serious impediment to the final success of the case.

After the operation both eyes must be kept closed for twenty-four hours, at the end of which time the needle-wound is usually united, and the aqueous chamber refilled. From the second day it will only be necessary to close the operated eye, and after a few days a shade may be substituted, and then that may be laid aside for a pair of tinted glasses. The day after the operation atropine should be reapplied, and its use continued so long as any sclerotic zone remains, or so long as the swollen and macerated lens threatens to press upon the iris. Day by day the white flocculent lens-tissue continues to pass through the opening in the capsule; and if the pupil is not kept well dilated, so as to make room for the increasing bulk of the lens, the iris will become inflamed, and pain will be set up in the eye.

No absolute rule can be laid down as to how often and at what intervals it will be necessary to repeat the needle-operation. In exceptional cases I have known a single operation suffice for the total absorption of the lens even in an adult: and in a healthy infant, after completely breaking up the lenses, I have seen both of them wholly absorbed at the end of two months. More commonly, it is necessary in children and young persons to repeat the disintegration of the lens a second time, at an interval of some months after the first operation, and a finishing touch with the needle may subsequently be required thoroughly to clear the pupil from capsule. It is important not to be premature in performing this final operation on the capsule, for during the process of absorption it undergoes so many changes of position by shrinking, that time should be allowed for it to settle into its permanent position before the final laceration of it is made.

If, from peculiar circumstances, it be thought advisable to procure the solution of the lens in an elderly person, or in one whose power of absorption is very feeble—or in a case where the lens is of that peculiar waxy consistence which renders it so little disposed to imbibe the aqueous fluid, and become loosened up and flocculent, the surgeon must be prepared to use the needle more frequently; for, in these instances, solution proceeds at a very slow rate, only just the quantity of lens-tissue which is crumbled off at the time of the operation being absorbed, and then no advance being made until a fresh portion of the lens is dug out.

Under these conditions, it may be necessary to employ the needle every two months; and if slight attacks of inflammation occur to interrupt the process of absorption, even longer intervals must be allowed, so that a twelvemonth or more may elapse before a perfectly clear aperture through the centre of the lens is obtained.

In an adult it sometimes happens that, either on account of the lens having been too much broken up at once, or in consequence of the absorbing power having been checked by inflammation, the eye becomes oppressed by the displaced fragments of lens; the sclerotic and conjunctiva then become injected, there is intolerance of light and profuse lacrymation, the iris becomes discoloured, the aqueous humours turbid, the cornea hazy and uneven on its epithelial surface. When these symptoms set in, the eye will be lost by chronic inflammation, unless it be forthwith relieved from the pressure of the swollen lens. The lids being separated with the spring speculum, and the globe steadied with a forceps, an incision is to be made in the cornea close to its margin, and through this a small scoop or spatula is to be introduced into the anterior chamber. The softer pulpy portion of the lens will then escape along the groove of the scoop, or by the side of the spatula when it is rotated; and if this operation has been resorted to in time, an eye which had presented all the phenomena just described may be speedily restored to a healthy state, and that portion of the lens which has been left *in situ* will steadily undergo complete solution.

When a perfectly *fluid cataract*, or one which has to a very great extent undergone the fluid change, is operated on with the needle, it almost invariably happens that distressing nausea and violent vomiting set in immediately; and in some cases I have known this state of sickness, attended with intense neuralgia, to continue for twenty-four or thirty-six hours. As soon as the capsule is punctured with the needle, a puff of creamy fluid takes place into the anterior chamber, and a farther escape of this fluid conceals the iris from view. If nothing farther is done, the distressing sickness is almost sure to set in; but if the surgeon gently withdraws his needle, and immediately introduces at the same spot a broad cutting-needle, or the point of a cataract-knife, and rotates the blade, the whole of the milky fluid is evacuated, and the sickness is wholly or to a great extent averted. The nausea is best combated by allowing the patient frequently to swallow small fragments of ice; and the neuralgia in the ophthalmic division of the fifth nerve will probably yield to the application of chloroform liniment, applied by means of lint to the forehead and temple.

Operations on opaque capsule.—It sometimes happens that, in breaking up a cataract with the needle, the anterior and posterior portions of the capsule are so effectually lacerated, that they retract sufficiently to leave the area of the pupil unobstructed; but these are exceptional cases, and usually, after the lens-tissue has been wholly absorbed, there remain some portions of opaque capsule, which must be removed before the cure can be considered complete.

Capsular obstructions are likewise met with after extraction of the lens; and it seems desirable, therefore, to defer the consideration of them until the operations of extraction have been described.

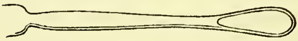
OPERATIONS OF EXTRACTION.

The solution and absorption of a cataract in an old person is an extremely slow process, partly on account of the density and impermeability of the nucleus of the lens, and partly in consequence of the diminished activity in the interchange of material which characterises the tissues of the body in old age.

A more rapid removal of the opaque lens, therefore, becomes desirable; and although special circumstances may induce the surgeon to employ the operation for solution in patients above forty, or even fifty years of age, he will find it preferable, in the majority of instances, to have recourse to extraction.

Until within the last few years, the term 'Extraction,' had but one meaning—the removal of a cataract through a flap wound of the cornea. But in 1855 Graefe re-introduced and modified, under the name of 'Linear Extraction,' an operation which had first been devised by Gibson in 1811, and at a later period he invented an entirely new operation in which, after removing a portion of iris, he drew out the cataract with a scoop.* This scoop, first invented by Graefe in 1857, was modified by one of his assistants, and on the strength of this mere change in the shape of the instrument the whole procedure itself became universally known, not as Graefe's—which it undoubtedly was —but as Schuft's operation.† Other surgeons in Germany have modified Graefe's invention in various ways, but their operations are all substantially the same in principle as that which he originally devised.

Fig. 147.



We may group the various forms of extraction under three heads:—*Flap-Extraction*, *Rectilinear-Extraction*, and *Scoop-Extraction*.

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* The woodcut is copied from a scoop made for Graefe in 1857.

† Schuft changed his name to Waldau.

FLAP EXTRACTION.

This operation, as now practised, cannot be said to have originated with any one surgeon, but has been gradually perfected from a very rude beginning. Daviel has the credit of having performed it for the first time during the earlier half of the eighteenth century; and he professed to have derived the first hint of the operation from his countryman Petit, who, in 1708, had made an opening in the cornea to give exit to a dislocated lens. But Daviel's clumsy and complicated proceeding can only be regarded as a very rough approximation to the delicate operations of the present day. He first, with a lancet, punctured the cornea near its lower edge; then he enlarged the wound with a narrow knife, blunt at the end, but cutting on each side; and, lastly, completed his incision with scissors. Other surgeons simplified the operation by making the section with a knife only; they continued, however, to do this at the lower part of the cornea, a situation very unfavourable for quick union, inasmuch as the edge of the corneal flap was liable to catch against the lower tarsus, and so become displaced. B. Bell seems to have been one of the first to suggest the practicability of the upward section; but it is difficult to say by whom this great improvement in the operation was really established. It seems to have made its way by slow degrees, commending itself to several independent operators by its evident superiority.

It is to Beer that we owe, if not the invention, at least the systematic introduction, of the knife which still bears his name, and has superseded all other instruments for making the corneal section. This, however, Beer continued to make in a downward direction.

But it was not exclusively, or chiefly, by means of improved instruments, or by greater skill in using them, that increased success in the operation of extraction was to be attained.

The astounding plan of after-treatment which so long prevailed, and the remains of which still linger among us, makes us wonder, not that so many eyes were formerly lost after extraction, but that any were saved. Low diet, carried to the verge of starvation—profuse bleeding, both general and local—active purging and mercurialisation, and long confinement to dark rooms—formed a course of discipline by which surgeons hoped to heal a wound inflicted on a structure devoid of blood-vessels, and peculiarly liable, therefore, to slough or ulcerate whenever its vitality was lowered by any exhausting agencies. These surgeons saw the cornea die in persons worn out with scarlet-fever, erysipelas, small-pox, or typhus; and yet, in the after-treatment of extraction, they seemed bent upon reducing the patient as near as possible to the same condition as those diseases would have done.

I shall have occasion hereafter to speak of the after-treatment of cases of extraction; at present we have to consider the operation itself.

The objects to be kept in view are the following:—

To make a crescentic opening in the cornea sufficiently large to afford an easy exit to the lens. To make the incision at such a distance from the sclerotic as to insure both edges of the wound being wholly of corneal tissue: for wounds of the true cornea, provided their edges are in perfect apposition, have a peculiar readiness to unite—a property not equally shared by that extreme marginal portion of the cornea which blends with the sclerotic. Freely to lacerate the anterior capsule, so as to allow of the lens readily slipping through the rent when pressure is made on the globe. Lastly, to apply this pressure in such a manner that the lens may be made slowly to turn on its transverse axis, and thus to present its upper margin first at the pupil, and then at the corneal wound.

If we reflect, that the surgeon's object is to dislodge and press out the lens, at the same time that he avoids pressing out any portion of the vitreous body, it must be evident that extreme care and delicate handling are necessary. The pressure must be regulated with a nicety which is hardly possible unless the operator has the eyeball under his sole management. The best position for the patient, therefore, is to lie upon a high couch, with his head alone slightly raised. The surgeon, standing or sitting behind him, can then control the movements both of the upper lid and of the eyeball. Formerly the patient was always seated on a chair, the surgeon sitting opposite to him, while an assistant steadied the patient's head, and raised the upper lid. But in this way it was impossible for the patient's head to be fixed as immovably as if it were resting on a couch; nor could an assistant, however careful, regulate the pressure he made on the eyeball in exact accordance with that exerted upon it by the operator.

The chief difficulty attending the formation of a proper section through the cornea arises from the fact that the knife has to be carried across a chamber filled with a fluid, ready to escape at the smallest opening which the blade of the instrument may leave unguarded; while the instant such an escape takes place, the elasticity of the contents of the eyeball forces the iris forwards over the edge of the instrument. The sawing motion we employ in using a scalpel, or any other kind of surgical knife, would be inadmissible in making a section of the cornea, inasmuch as each to-and-fro movement of the blade would allow of a fresh escape of aqueous humour, or would inflict a wound on the iris, when that structure had come forward to fill up the place of the lost fluid. Hence arose the necessity for a blade regularly increasing in width and thickness from the point to the heel. Such an instrument, if steadily carried on in one direction, without any rotation, completes the wound at a single thrust, while its wedge-like form prevents the premature escape of the aqueous humour, and so lessens the danger of wounding the iris.

It would be very unprofitable to enter into a description of the various cataract-knives which at different times have been invented. One operator after another has endeavoured, by alterations in the shape of the blade, to overcome the special difficulty which has most beset him; but surgeons are now pretty generally agreed that the instrument which goes by the name of Beer's* knife is, with certain modifications, the most useful, and that no merely mechanical contrivance can obviate all the difficulties attending the operation of extraction.

At the time when Beer wrote, and, indeed, long afterwards, the flap was always made at the lower part of the cornea; but the upper section has been found to possess such advantages, that the lower one has completely fallen into disuse.

The patient being placed in the manner described, the surgeon standing or sitting behind him, raises the upper lid, placing his fingers against the very edge of the tarsus, so as to prevent eversion. An assistant draws the lower lid downwards, and keeps it fixed by making pressure against the malar bone. He must take especial care to do this, and not in the slightest degree to press upon the eyeball. The surgeon may control its movements by allowing the tip of one finger lightly to touch the sclerotic just above the cornea, while the other rests, as lightly, against the inner side of the globe. To do this safely requires the greatest tact and care; for, as soon as the knife has transfixed both sides of the cornea, all pressure must cease, and it ought at no time to be greater than will just suffice to enable the surgeon to make his puncture and counter-puncture with certainty. Firm pressure, kept up till the section is completed, will almost inevitably cause the lens to be violently ejected, with a gush of vitreous humour.

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* It seems that both Casamata and Barth had employed a knife of the same shape as Beer's, but larger. Casamata's knife, if correctly figured by Wenzel (*Manuel de l'Oculiste*, 1808), resembled Beer's in shape, although there might be some slight difference of size. Beer insists, with amusing earnestness, upon the absolute necessity of the knife being made precisely according to his pattern—so many lines long and so many broad; if people pretend to operate in his way, and yet deviate from the exact pattern he has laid before them, he will not hold himself responsible for the consequences. (*Lehre von den Augenkrankheiten*, 1817, vol. ii. p. xlvi.)

The point of the knife is to be introduced on the equator of the cornea, a short distance in front of its junction with the sclerotic, carried steadily across the anterior chamber, and brought out at the corresponding spot near the inner margin of the cornea. During this thrust the edge is directed towards the upper margin of the cornea, so that, when the section is completed, a semi-lunar flap results.

The surgeon must take care to give the knife a steady onward pressure, so that the blade may constantly fill up the wound it is making. If he in the least withdraws the knife or rotates it, or if he attempts too soon to cut out, instead of thrusting straight on, a jet of aqueous humour takes places at that portion of the wound which is no longer filled by the blade, and then the iris instantly folds over the edge—one of the most troublesome occurrences that can attend the operation. The utmost care, however, will not always avail to prevent the loss of aqueous humour; for so ready is the fluid to spurt out, that, if the sides of the knife be unevenly ground, sufficient space may exist between the blade and the edges of the wound to allow of the escape.

If the iris has fairly come over the edge of the knife, the surgeon may disengage it by drawing the point of one finger over the cornea, from below upwards, and then making a little pressure directly backwards. In this way the iris may be made to slip back behind the edge, and by keeping up careful pressure until the section is nearly completed, the iris may be prevented from coming forward again. It is not possible precisely to describe this manœuvre for disengaging the iris; the pressure employed should be extremely delicate and guarded, and should be wholly taken off before the very last portion of cornea is divided.

The operator may find it impossible wholly to disengage the iris from the knife, and a portion of the upper margin of the pupil may be cut away. This of course causes a slight bleeding into the anterior chamber, which obscures a view of the parts during the next stage of the operation, but the lens usually escapes readily through the artificially enlarged pupil, and, except the deformity, no permanent bad result necessarily follows the accident. Sometimes, however, it happens that a *fold* of the iris is cut through, so that there results a hole in the iris just above the true pupil. When this occurs, the surgeon must at once divide the strip of iris between the two apertures, so as to lay them into one before he proceeds to lacerate the capsule.

As soon as the corneal flap has been completed, the upper lid is allowed gently to fall, care being taken that it does not catch against the edge of the flap and evert it; and the surgeon proceeds to the second stage of the operation—the division of the anterior capsule.

After a short pause, he again carefully raises the upper lid, without making pressure on the globe, and surveys the wound. If he has made it too small, he must at once enlarge it, by passing a short, narrow, blunt-ended knife, or the blade of a pair of scissors, under the flap, to the outer angle of the wound, and carefully dividing the cornea close along its margin, in a downward direction.

This enlargement of the original wound is always very difficult, on account of the unresisting state of the loose flap of cornea, and the irritability of the eye, which the surgeon dares not then control by pressure, for fear of prematurely displacing the lens. An able assistant, who can be trusted not to press upon the globe, may often render good service in this difficulty, by nipping up in a forceps a fold of conjunctiva, just below the cornea. Scissors curved on the edges will be found preferable to the knife for enlarging the wound. No difficulty should deter the surgeon from making the wound sufficiently large before attempting to press out the lens; for if, while the opening in the cornea is too small, pressure be made on the globe, the hyaloid membrane will probably give way, and allow a portion of the vitreous humour to escape; and immediately the lens, instead of presenting itself at the section, sinks down into the space left by the lost humour.

When this occurs, the surgeon must at once desist from all pressure on the globe, and pass in a fine sharp hook through the now gaping wound, and through the pupil, to the hinder surface of the lens, which must be drawn out as quickly and as lightly as possible. Sometimes it is better to pass in a flat scoop instead of the hook; but, whichever instrument is employed, it must be placed *behind* the lens, which is to be kept well pressed against the cornea, otherwise it will be driven still deeper into the vitreous humour.

If the surgeon has satisfied himself that the corneal wound is sufficiently large to allow of the easy exit of the lens—and for this purpose it ought to involve nearly half the circumference of the cornea—he next proceeds to lacerate the anterior capsule. The curved needle * is slipped under the corneal flap, care being taken not to entangle the point in the iris; and when its curve is fairly in the pupil, the handle is rotated so as to bring its point against the capsule. Some writers give very precise rules as to the manner in which the capsule is to be divided. One recommends a crucial incision; another tells us to make a series of cuts crossing each other at right angles, so that the lines of incision may include a number of lozenge-shaped interspaces—a figure, one would think, rather difficult to execute within the area of the pupil, even in a motionless dead eye, and certainly not practicable upon the irritable eye of a patient under operation.

In tearing through the capsule, the surgeon should take care that the rents extend quite across the area of the pupil; and if he effects laceration to this extent, he need not trouble himself about lines of incision depicted in diagrams. The laceration of the capsule requires a careful eye and a light hand, otherwise the lens itself may be displaced, the capsule remaining unbroken.

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* By a curious misnomer, this needle is commonly termed in England the 'curette.' The mistake arose from an accidental circumstance. The instrument for lacerating the capsule was originally called by the French *cystitome*; the scoop, attributed to Daviel, was called *curette*. It was found convenient to mount these two instruments on the opposite ends of the same handle; and our countrymen, forgetting the meaning of *curette*, have applied that name to the sharp cystitome instead of to the scoop. It is time that we called the things by their right names; for foreigners, in reading reports of English cases, must often have been sorely puzzled to understand how we lacerated a capsule, or transfixed a lens, with a *curette!*

The needle having been withdrawn, with due care against entangling it in the iris, the surgeon proceeds to the last act of the operation—the removal of the lens.

It is a fatal error to suppose that this removal is to be effected by main force ; that the eye may be squeezed in any direction, if only it is squeezed hard enough. The real object of pressure is to make the lens first turn on its transverse axis, so that its upper edge may become tilted a little forwards. To effect this, the concavity of the scoop is laid against the lower lid—which the assistant is not to touch during this stage of the operation—and gentle pressure is to be applied through the lid against the sclerotic, a little beneath the lower margin of the cornea. With the forefinger of the hand which holds the upper lid, similar gentle pressure is made on the upper part of the globe, just above the section ; and then, by a carefully-regulated alternating pressure on these two points, the lens is made slowly to turn and present its upper edge at the pupil. Coming in contact with the cornea, the edge of the lens is guided upwards, and begins to protrude at the corneal wound. It is evident that as soon as the widest part of the lens has passed through the pupil, the rest will be inclined rapidly to follow; and therefore, if the surgeon does not moderate his pressure, the lens will suddenly start forward, and will very probably be followed by a gush of vitreous humour. According to the size of the corneal wound, and the degree of superficial softening the cataract has undergone, will be the amount of soft matter the lens will leave behind in passing out of the eye. A small lens will perhaps escape entire through a large wound ; while if the wound be small, and the lens bulky and much softened on its surface, a considerable quantity of lens-matter will remain in the pupil and about the lips of the wound.

Quick union of the corneal wound, upon which so much of the success of the operation depends, cannot take place if any foreign matter be allowed to remain between its edges; all soft lens-matter, therefore, which may be sticking there, must be carefully removed with the scoop. The iris, which very frequently protrudes, can be best returned to its position by means of the small spatula. It is unwise to dip again and again into the pupil with the scoop for the purpose of removing every portion of soft lens-matter. The capsule cannot be removed by such means; and it is to this that the fragments very often adhere, and a too free use of the scoop is very likely to rupture the hyaloid membrane, and cause a gush of vitreous humour.

Provided the lips of the wound are in perfect apposition, and the iris in its proper place—which may be known by the central position of the pupil—the capsule, and any small portions of entangled lens-matter, may safely be left for future removal, after the wound is healed and all irritation passed away.

When a gush of vitreous humour takes place at the moment the lens passes, the surgeon must immediately close down the upper lid, lifting it over the wound by the eyelashes, so as to prevent the edge of the tarsus catching against the projecting flap of cornea. Any prolonged examination of the wound can only lead to fresh escape of vitreous humour. After a slight pause, the surgeon, again grasping the lashes of the upper lid, may gently raise it, just sufficiently to assure himself that the flap is not doubled down, as frequently happens. Having ascertained that this displacement has not occurred, he must be satisfied, and not wait in the expectation of seeing the wound close; for the constant tendency of the vitreous humour to escape will render any adjustment of the flap impossible. The lids must at once be closed with strips of plaster and a bandage.

Although cases in which a small quantity of vitreous humour has been lost may ultimately do well, a deformity of the pupil always remains. It is large and drawn up towards the wound, and the iris forming the upper margin of the pupil retracts, so as to disappear altogether.

In the foregoing description of the operation by extraction, I have noticed some of the accidents that are liable to occur; but there remains to be noticed one more dangerous than all others, namely, *hæmorrhage into the vitreous chamber.*

Although the corneal section may have been perfectly well made, and every due precaution taken, it sometimes happens that a gush of vitreous humour, usually of watery consistence, occurs at the moment the lens escapes through the wound. Within a few seconds, or at the end of a minute or two, the patient complains of severe pain in the eye, and blood appears oozing from between the lids. This oozing does not take place until the whole cavity of the eyeball has become filled with blood. In some instances, the hæmorrhage sets in several hours after the operation. Some diseased condition of the deep-seated tissues must exist in all these cases—a change of structure in the vessels of the choroid, with or without serous effusion between it and the retina. I need hardly say that, in all these instances of hæmorrhage, sight is utterly lost.

A similar hæmorrhage sometimes follows the removal of staphylomatous projections of the globe. As soon as the prominent portion of the staphyloma has been cut off, the pent-up aqueous fluid and serum, and the diffluent vitreous humour, gush out at the wound; and this sudden removal of support from the enlarged choroidal vessels causes them to give way. In such cases, I have found the whole retina enveloping the large clot which had been forced out of the eyeball; a proof that the blood which had detached the retina must have had its source behind that structure, namely, from the vessels of the choroid.*

AFTER-TREATMENT OF CASES OF EXTRACTION.

The prevalent belief that all operations for cataract are likely to be followed by 'inflammation,' and that the great aim of the surgeon is to keep this down, is of course unqualified in the popular mind by any definite notion as to the nature of this 'inflammation,' why it arises, or what parts of the eye it involves; and many members of the profession, when commencing the study of eye-diseases, have equally vague conceptions of the subject. Let us, then, examine a little into what takes place in an eye after flap-extraction of cataract. We will assume that the structure of the organ, with the exception of the lens, had been in a healthy condition, and that the operation has been skilfully performed.

The cornea has been divided, by a clean cut, to the extent of half its circumference; the aqueous fluid has escaped; the lens has been gently squeezed through the pupil; the iris is in contact with the hinder surface of the cornea, the cut edges of which are in exact apposition; the concave surface of the upper lid lies against the wound, and affords it support.

Within a few hours—provided the nutrition of the patient's body is in a healthy state—adhesion takes place between the cut edges of the cornea. As this adhesion becomes firm, the aqueous humour is retained; it once more fills the anterior chamber, and defends the iris from being pressed against the cornea. The slight irritation to which the iris had been subjected, by the passage of the lens through the pupil, passes off, and within a period longer or shorter, according to the constitution of the patient, the extra quantity of blood, which had been affording reparative material to unite the wound, ceases to be sent thither, and the cure is completed.

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* I published two cases of this kind in the *Lancet*, 1845, p. 623.

This is just what happens in accidental wounds of the cornea. If the patient be at the time in a good state of health —the wound a clean cut, unattended with contusion—with no iris or other substance interposed between its edges—and if the eye be carefully kept at rest, and defended from the action of light and other irritants—a few days suffice to heal the wound. But let a similar injury be inflicted on the eye of a person feeble from age—or of one reduced to feebleness by want—or of one alternately excited and depressed by intemperance—and suppose the first two patients to be bled and restricted to low diet, while the third continues his indulgence in alcohol—what will *then* be the result? Non-union of the wound; partial or total slough of the cornea; and morbid changes in the iris and adjacent tissues; finally, loss of the eye, as far as sight is concerned.

And now let us apply these facts to a case of extraction. If the operation has been properly conducted, and all has gone well, in the manner already described, healing of the wound is the natural result. No more blood will be sent to it than the healing-process requires; and as soon as the process is completed, the extra supply will cease.

On the other hand, if the iris has been forced into the wound, a mechanical obstacle to quick union is thereby established, and union must take place by a slower process, effused lymph agglutinating the iris to the cut edges of the cornea, and then gradually drawing them together. If vitreous humour has escaped through the wound, its edges will be kept asunder for some time, but will eventually unite by adhesion.

If quick union is prevented by these or any other causes, what good can *bleeding* do? Will it dislodge the iris from between the lips of the wound? or, when the hyaloid membrane has been ruptured, will it prevent the vitreous body from protruding where it meets with the least resistance? As reasonably might we expect by bleeding to dislodge a piece of muscle that was preventing union by lying between the two ends of a fractured bone.

The pain which not unfrequently sets in a few hours after an extraction is commonly of a neuralgic kind. The patient's nervous system has been excited by anxiety about the operation itself, or its result. Bleeding is sure to increase this neuralgia; while a due supply of digestible food, a small quantity of stimulus, or a narcotic, will at once arrest the neuralgia and prevent its recurrence. And yet, only forty years ago, such doctrines as the following were taught *ex cathedrâ*, and are still accepted and followed by many in this country, and by a far greater number of surgeons on the Continent:—that within a few hours after the operation of extraction a quantity of blood should *always* be abstracted, *whether pain come or not*; —that 'from four to eight hours after the operation, unless pain has come on sooner, blood is again to be drawn from a large orifice,'—and yet again, 'if pain should come on afterwards, or continue.' For the first five days after the operation —while the patient is being drained of blood in this manner— his diet is to consist of 'nothing but gruel, tea, arrowroot, and panada.' *

Extraction of cataract is an operation performed on those who are past the middle period of life, and one naturally expects to find among them many of those conditions of feebleness and impaired function which are incident to old age. No doubt cases occur of an opposite kind, in which the patients are plethoric, over-fed, over-stimulated with alcohol. They require to be 'toned down,' and their circulation brought into a more healthy state. But then this should be done by regulating their plan of living for several months *before* the operation is performed; not by bleeding them just *after*, and thus placing them in a new and unnatural condition at a period so critical.

The profession is chiefly indebted to the late Frederick Tyrrell for the introduction of a more rational and simple method of treating patients after extraction and other operations on the eye; although he did not so completely abandon bleeding as I am convinced he would have done had he been spared to acquire firmer faith in the *vis medicatrix naturæ.**

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* Guthrie, *Lectures on the Operative Surgery of the Eye*, 2nd edit. 1827, p. 347.

As soon as an operation of extraction has been completed, and the surgeon has satisfied himself that the flap is in a proper position, he should at once close the eye, without permitting any such trials of the patient's sight as may safely be made after the removal of opaque capsule, or the formation of an artificial pupil. Such trials, immediately after extraction, are more likely to disappoint than to satisfy the patient; for when the media of the eye have just been disturbed, and the pupil is still encumbered with shreds of capsule, and perhaps fragments of lens also, objects must necessarily appear to the patient distorted and confused; whilst the opening and shutting of the lids is liable to displace the corneal flap. An assurance from the surgeon that all has gone well, and that, to restore good sight, time and patience only are needed, will effect much more towards tranquillising the patient than any premature experiments.

Both eyes are to be covered with pieces of folded linen, which are kept in place by a light bandage passing around the head. Some surgeons apply strips of plaster across the lids, instead of a bandage; but I prefer the latter, as it effectually excludes light, and therefore does away with the necessity for darkening the room, while it affords to the patient a sense of security and protection. Liebreich's bandage is a great improvement on the old linen blinkers and roller; for it always keeps in place, and can be unfastened without moving the patient's head. A little square of linen is laid upon the closed lids, and over this a little pile of cotton-wool, and the whole is then fastened down with the knitted bandage.

For some hours after the operation the patient should remain on the couch, comfortably supported with pillows. When in bed the best position is on the back; but this is by no means to be insisted on if it becomes irksome, or makes the patient wakeful. That position is the best which is the most comfortable, and likely to induce sleep.

A narcotic is sometimes needed on the first night; and in some persons, especially those accustomed to opiates, it may require to be repeated for several nights in succession; but such cases form the exception, not the rule. Loss of appetite is so apt to follow the use of these drugs, that they should never be given without manifest necessity. I always prefer tincture of hyoscyamus to opium, as being far less likely to cause discomfort the next day or to confine the bowels.

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* For much valuable information on this subject, consult vol. ii. of his *Practical Work,* &c.

The patient is of course to be thoroughly waited upon, so as to be spared every unnecessary movement or exertion. Tapes passed round the wrists and attached to the sides of the bedstead are a useful check upon sudden movements of the hands during sleep.

A moderate dose of opening medicine, given a day or two before the operation, will obviate the necessity for teasing the patient with purgatives during the first few days succeeding it. Old and feeble persons, especially those with any heart-disease, are sometimes seriously prostrated by being purged on the second or third day after the operation, just when it is so important that the healing process should be steadily advancing.

As regards diet, patients should not be deterred from taking a nutritious meal a suitable time before the operation; and a moderate quantity of easily-digested animal food should be given on each following day. In respect of stimulants, it is impossible to lay down any absolute rule. Those accustomed to take wine, beer, or spirits, must by no means be wholly debarred from them at a time when the nutrient power of the body is called upon to form new material for repairing a breach of surface. In short, the surgeon's object must be carefully to regulate both food and stimulants according to the patient's previous habits; neither keeping him too high nor too low, but as near as possible up to the ordinary level of healthy vigour.

The daily cleansing of the lids requires caution; the object not being to prevent the eyelashes sticking together, for their agglutination forms the best safeguard against the patient prematurely opening the eye. The lower lid and cheek are to be cleansed with warm water, but the upper lid is on no account to be touched, for under its shelter lies the corneal wound, sudden pressure on which would induce great suffering, and might even cause the slightly-formed adhesion of the flap to give way.

The progress of the wound towards healing is to be judged of by the condition of the lid, and the quality of the secretion. If the patient complains only of an occasional pricking, or a sensation of grit; and if this can be traced to the slight involuntary movements of the wound against the lid; if this uneasiness subsides day by day; if the secretion consists of tears alone, or is mixed with a little of the natural conjunctival mucus; and if the skin of the upper eyelid retains its healthy appearance, and is free from redness and swelling—the surgeon may entertain the best hopes that a good union is going on.

An increased feeling of grit in the eye, coming on after the lapse of three or four days, and perhaps attended with neuralgia, would lead the surgeon to suspect that the section had yielded, and that *prolapsus iridis* had occurred.

The most unfavourable sign is a bright redness and a swelling of the upper lid, which sometimes appear on the second or third day after the operation, attended with a yellow puriform discharge. These appearances are commonly ushered in by a restless night, with headache and considerable depression both of body and mind. When the lid is raised, the ocular conjunctiva is found injected, and so œdematous that it overlaps the corneal margin (*chemosis*). The cornea itself is throughout yellow and opaque, so that no trace of iris can be discerned through it; the wound is gaping, and filled with bulging iris. Eventually the whole cornea softens, the flap sloughs, and the eyeball shrinks.

I have now and then seen this hopeless state of things come on after an operation, which had been perfectly well performed, and when the surgeon had every reason to expect a most successful result. In such cases there has probably been some degeneration of tissue in the vessels supplying the globe, and a weak condition of the heart itself.

The time that should be allowed to elapse after the operation, before the eye is examined, may vary according to circumstances. In a healthy patient, when there has been no pain in the eye, or other bad symptom, the wound may be found perfectly united as early as the third day after the operation. But, as a rule, the fourth day is quite soon enough for an examination; and whenever there has been any loss of vitreous humour, so that the healing process has been retarded, the fifth will be the earliest day on which the eye can be prudently exposed. Indeed, in an old or feeble person, a wound which on the fourth day is going on well, will be all the better for another day of rest; and it often happens that a premature exposure sets up irritation, and, if the union be not firm, favours the subsequent yielding of the wound and prolapse of the iris.

If redness of the upper lid, attended with puriform discharge, comes on within the first two or three days, the surgeon should examine the eye just so far as to obtain a view of the lower part of the cornea, and ascertain whether it is becoming infiltrated with pus; and this may be done without exposing the wound itself.

It would be impossible to detail all the appearances which an eye may present when first examined after the operation; but it may be useful to describe some of the leading points which present themselves, both in favourable and in unfavourable cases.

1. The cornea may be transparent, with the exception of a little hazy line along the edge of the wound; the aqueous humour may have been resecreted, and the plane of the iris vertical; the pupil being either clear and black, or filled with a flocculent mass of capsule and lens-matter, accordingly as the lens has come out clean, through a large wound, or has rubbed off some of its soft cortical substance in passing through a small one. Vision may extend to the recognition of large objects, such as the fingers of a hand; or, in consequence of the obstruction still remaining in the pupil, may be limited to mere perception of direct or reflected light. Some little redness of the sclerotic and conjunctiva will of course be present in every case, an additional supply of blood having been sent to repair the corneal wound.

The appearances above described are most satisfactory, and would encourage the surgeon to look forward to a successful result.

2. The eye may present all the foregoing appearances, with the exception of the iris being in contact with the hinder surface of the cornea. This absence of anterior chamber arises from one or other of the following causes: either the wound, although sufficiently united to keep the cornea in its proper curve, has not become so consolidated as to be perfectly watertight, and the aqueous humour therefore escapes as fast as it is formed; or else this fluid, which seems to be chiefly secreted in the posterior aqueous chamber, may be so pent up there by the lens-matter filling the pupil, as to thrust the whole iris forwards against the cornea. In the former case, by keeping the eye closed for two or three days longer, and giving the patient a

little more stimulus or tonic, the wound will become consolidated. In the other case, the iris will slowly recede as the lens-matter in the pupil becomes absorbed, but perhaps will not quite resume its vertical position until the capsule at a later period shall have been broken through with a needle.

It occasionally happens that although the corneal wound, when examined on the fourth or fifth day, appears well united, it subsequently gives way a little at some point, and allows a small portion of the iris to protrude, so as to cause slight displacement of the pupil.

3. The eye may be found in the following state: the cornea clear, the section gaping, and blocked up with iris, the latter having prolapsed into the wound, after being adjusted at the operation, and no union between the two structures having occurred, in consequence of the feeble condition of the patient. In these cases the parts on the fourth day after the operation may appear almost as if the wound had been just inflicted. Chronic inflammation is sure to be set up, and is often attended with neuralgia. In non-union of this kind, it is sometimes good practice to keep the eye uninterruptedly closed for five or six days after the first examination, provided the healthy appearance of the lids, and the absence of puriform secretion, give assurance that the healing process is advancing.

4. Still more unfavourable than the appearances above described are the following: in addition to a gaping section and prolapsus iridis, a cornea hazy throughout, so that the iris cannot be clearly discerned; the edges of the wound thickened, opaque, and creamy-looking; the sub-conjunctival tissue infiltrated with serum, and the conjunctiva itself reddened and elevated (*chemosis*).

These local changes have usually been ushered in with pain in the eye and head, restlessness, and depression. Extreme care is necessary to treat a patient under such circumstances. Narcotics will probably be required at night; of these hyoscyamus is the best, and bark and ammonia are almost sure to render good service in keeping up the appetite and restoring vigour to the flagging circulation. The diet will require the most careful management, so as to insure a sufficiency of nourishment being taken without oppressing the stomach; above all, the regulation of the supply of stimulants—wine or beer—will demand much judgment on the part of the surgeon, so that the patient's powers may be raised and sustained, without causing irritability and subsequent depression. But it will sometimes happen, in spite of care and skill, that such cases as these will terminate in closure of the pupil, with wasting and softening of the whole globe.

Although it is so important, after the operation of extraction, to defend the patient from strong light for several days, there is no necessity for closing shutters, and drawing curtains closely round the bed, if the patient's eyes have been bandaged in the manner I have described. Very moderate shading of the room is then sufficient, and thorough ventilation is most beneficial; for due aeration of the patient's blood is essential to the healing process.

Prolapsus iridis.—If the corneal section, instead of uniting by adhesion, has undergone that slower process of closure which takes place when a portion of iris is interposed between the edges of the wound, the *prolapsus* continues for some time to be a source of irritation. It should not, however, be too hastily interfered with; for, in healthy subjects, it usually wastes and flattens down by slow degrees. Sometimes, however, instead of diminishing in this manner, it becomes distended into a little vesicle, in consequence of the accumulation of aqueous humour behind it. If the prolapsus fills up nearly the whole extent of the wound, the corneal flap may be tilted forward in such a manner as to form an obtuse angle with the lower portion, the base of the flap being marked by a transverse crease, extending quite across the cornea from one angle of the wound to the other. As the process of contraction in the prolapsed iris goes on, the edges of the corneal wound are gradually drawn together, the transverse crease disappears, and the natural curve of the cornea is eventually restored.

If, however, instead of diminishing, the prolapsus remains as a large and prominent vesicular projection several weeks after the operation, means must be taken to induce it to contract. In many cases it is sufficient to puncture it with a broad needle, and, when the aqueous humour distending it has escaped, to touch the collapsed iris very lightly with a point of nitrate of silver. The eye must then be kept closed for a day or two. Should the prominence reappear, the application of the nitrate of silver may require to be repeated; but it must never be used except with a light hand, a single touch being sufficient to whiten the surface.

Fistulous wound.—If a case be not well watched for several months after the operation of extraction, the wound may become fistulous. This is an extremely rare occurrence; so rare, indeed, as to be unnoticed by most of the authors on ophthalmic surgery. On this account, I will relate two cases which occurred under my own observation. In the first case, I could not quite satisfy myself as to whether the fistula resulted wholly from defective repair of the original wound made in extraction, or whether it was the consequence of a puncture I made in a very troublesome vesicular prolapsus.

In the second case, the prolapsed iris gave way spontaneously, many months after extraction, when the cure might have been considered complete.

1. Captain G., aged seventy-six, was operated on by extraction in the right eye, November 18, 1854. Nothing untoward occurred during the operation, and although a small portion of iris subsequently prolapsed into the wound, there was every reason to expect that its contraction and solidification would take place in the usual manner. By the end of the month, however, the prolapsus, instead of flattening down, became distended at one spot into a little vesicle. Meantime the pupil had of course become somewhat drawn upwards, and it was also obscured by a hazy condition of the flap; the lower half of the cornea always retaining its perfect transparency. On January 19, 1855, the vesicle still existed, and the anterior chamber had never been restored since the operation, the iris lying in contact with the cornea. It appeared to me, therefore, that at some part of the cicatrix a minute aperture must exist which allowed the aqueous humour slowly to exude. I punctured the vesicle with a cutting-needle, and touched the collapsed surface with a fine point of nitrate of silver. Three days later, I again touched it in the same manner. After a time the vesicle again became prominent; and on February 1, by the aid of a lens, I distinctly recognised the existence of a fistulous opening at its summit. The aperture was as minute as the section of a human hair, but pressure on the globe caused an escape of aqueous fluid to be distinctly perceived. I now coated a fine hair-like probe with a thin film of nitrate of silver, passed it quite into the minute fistulous track, and then kept the eye closed for several days. Meantime the patient's diet and allowance of stimulants, which had been liberal from the first, were increased. March 12, the vesicle had flattened down, but slight oozing from the fistula still continued. Nitrate of silver on the fine probe was twice repeated, at an interval of some days. By the end of May, the cicatrix of the wound was quite flat, but a very slight oozing of aqueous humour still continued; so slight, indeed, that some little accumulation took place in the anterior chamber, so that the iris and cornea, although very close together, were not in actual contact.

It was now evident that it would eventually be necessary to draw the pupil downwards, from behind the hazy portion of cornea adjoining the cicatrix, and so bring it opposite the clear portion below. But of what avail would this be, unless the fistula could be closed? It appeared to me, that by at once performing this displacement of the pupil, a double object might be attained, and that the wound made at the lower part of the cornea would for a time effectually drain off the aqueous humour, diverting it altogether from the fistula, which would thus be placed in a condition favourable to closure. Accordingly, on May 30, I made an opening at the lower part of the cornea with a broad needle; caught the lower edge of the pupil with a blunt hook, and drew out and cut off a very small portion of iris. An excellent pupil resulted. Ten days after the operation, I was much pleased to find the fistula closed and the aqueous humour completely retained, and this after a lapse of more than six months from the performance of extraction. Two years later, the patient was still enjoying excellent vision, both for far and near objects, reading the editorial articles in the *Times* with a glass of two inches and a half focus.

In the foregoing case I had been induced, by special considerations, to perform extraction at a very late period of the year; and the winter, which soon afterwards set in, was unusually cold and protracted. It will long be remembered as the terribly severe winter of the Crimean campaign. No doubt the low temperature contributed to lessen the reparative power of so old a person; and the long continuance of frost and cutting winds, which kept him confined to the house till May, deprived him of the invigorating influence of exposure to the open air.

2. An elderly woman, from whose left eye I had extracted a cataract in 1857, came to me two years afterwards, complaining that the sight of this eye, which had been very good ever since the operation, had within a few weeks begun to fail. On carefully examining the eye, I observed that near the middle of the cicatrix, which was rather broad in consequence of some slight prolapsus iridis having followed the operation, there was a minute fistula, through which the aqueous humour was slowly oozing. The anterior chamber was nearly full, and the plane of the iris almost vertical, the escape through the very minute aperture being counterbalanced by the secretion of fresh fluid. The fistula was so minute that it might easily have escaped notice, and it was only by absorbing the moisture adjacent to it with a bit of blotting-paper, and protecting it from the trickling-down of the tears, that the welling-up of the aqueous humour could be positively demonstrated. I had no doubt that this fistula was of very recent formation, for otherwise the patient would not have enjoyed such good sight as had existed until within a few weeks of her coming to me. Probably the cicatrix had always been thin and tense, and now from some accidental cause it had given way at the weakest point.

At first I tried the effect of touching the fistulous orifice with a fine probe coated with nitrate of silver. This was done twice, and for a few days after the second application it appeared to have been successful; but again the little channel opened itself. I then made a counter-puncture with a broad needle at the lower part of the cornea, and let out the aqueous humour, having just before again introduced the fine probe coated with nitrate of silver into the fistulous orifice. The lids were kept in contact with strips of plaster. A week later the fistula was completely closed, and sight was improving.*

These fistulæ of the cornea are likely to be overlooked, on account of their extreme minuteness; for their aperture is sometimes no larger than the section of a human hair, and the quantity of fluid oozing out is small in proportion. The fistula of course allows a constant escape of aqueous humour, and the anterior chamber becomes obliterated, the iris lying in contact with the cornea. This drain of aqueous humour, if unchecked, seems to exert some peculiarly exhausting influence upon the eye, for in all the cases I have seen in which fistulæ of the cornea had existed for several years, all useful vision had become extinct.

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* This case was reported in the *Medical Times and Gazette* for August 27, 1859.

There are certain points connected with the operation of flap extraction which may seem to have required notice before the operation itself was described; but it appeared preferable to reserve them for later consideration, because they can be properly appreciated by those only who have already made themselves acquainted with the details of the operation.

Inasmuch as extraction is performed upon persons more or less aged, it must often happen that the constitution of such patients has been damaged by various forms of acute or chronic disease before they come under our care as the subjects of cataract; so that we cannot expect to find them by any means in as favourable a condition for undergoing an operation as those whom we are in the habit of treating for many other surgical affections. There are, however, certain conditions which would either wholly contra-indicate extraction of cataract, or would cause us to undertake the operation only after the most careful preliminary examination, and unusual precautions against the more pressing difficulties of the case.

1. Extensive heart-disease is of all complications the most unfavourable; for, by enfeebling the supply of blood to the peripheral tissues of the body, it lessens the probability of a quick union of the corneal wound.

2. Violent cough, if occurring in suffocative paroxysms, would also greatly imperil the success of the operation; partly by the unavoidable restlessness and frequent change of posture, and partly by the straining and shaking of the eye, which may disturb the wound, and induce prolapsus of the iris.

3. Fat and flabby persons have much less reparative power than those who are thin. Dry and wrinkled, but still vigorous old people—such as are popularly termed 'wiry'—are of all others the best adapted to undergo extraction.

4. Certain morbid conditions tend to render the operation in various ways difficult, although they by no means forbid its performance. Total deafness, and deaf-dumbness, for instance, in

a great measure remove the patient from control; but I have successfully operated on patients under both these disadvantages.

5. Mere old age does not contra-indicate extraction; for one occasionally meets with persons of advanced years whose bodily functions are performed with surprising regularity.* Commonly, however, the reparative power of the cornea is impaired after seventy.

6. If cataract is equally advanced in both eyes, and both appear equally well suited for operation, ought we to extract both lenses at one sitting? On this question much difference of opinion exists. My own judgment is decidedly in favour of operating on one eye only at a time. We learn much by watching the progress of a case after operation, and often see how, by this or that precaution, or course of treatment, a difficulty or a bad result might have been avoided. We operate, for instance, on a depressible patient during very hot weather, and find him utterly overcome and prostrated by it, perhaps to such an extent as to induce non-union of the wound, or even partial slough of the cornea. Were this to occur after we had operated on one eye only, we should learn experience by the result, and take care to select a cooler season of the year for operating on the other eye.

Or our patient may have deceived us as to his previous habits. He may for years have been accustomed to take large quantities of stimulants, and our first operation may have failed because we had not kept up his reparative powers sufficiently by artificial aids. Having learned the truth, too late to save the first eye, we might be able, by adopting a different plan of after-treatment, to save the second.

Without unnecessarily multiplying illustrations, I may say that by operating on one eye at a time we secure to ourselves the advantage of making our first operation a means of invaluable instruction with respect to the second; while, at the same time, the effort of nature in repairing a single corneal wound is of course less than is required for the repair of a second wound of equal extent.

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* Such was the case with a gentleman of eighty-six, upon whom I operated by extraction. I could really detect in him no organic defect whatever, and he lived six years after the operation, in the enjoyment of excellent health and good sight. He then suddenly fell ill, became jaundiced, and died after a few days' confinement to his bed.

7. Ought we to operate when cataract is fully formed in one eye, while the other is either free from cataract, or only slightly impaired by its existence in an early stage?

Exceptional circumstances may make it desirable in such a case to operate on the cataractous eye; but in the great majority of cases it will be proper to wait until cataract is fully established in the other. Of course, after the extraction of the crystalline lens, a convex glass becomes necessary, to compensate for that portion of the optical apparatus of the organ which has been taken away; and it is almost, if not quite, impossible so to adjust any mechanical aids as to make the operated and the unoperated eye work well together. Each eye, taken separately, may be good; but there is a want of harmony between them which can never be reconciled.

8. The last question to be considered is, whether any particular time of the year is to be preferred for the performance of extraction? As far as the mere operation itself is concerned, I know of no period being positively contra-indicated, except the extremes of hot and cold weather. Severe cold acts unfavourably on old people by retarding the circulation of blood in their capillaries; while extreme heat enfeebles the action of the heart, especially when it happens—as is so common in old age—that some organic change has already taken place in it. The only time which I systematically avoid for performing extraction is during that sultry weather which sometimes visits us in July and August.

But one has to consider not merely the operation itself; the period of complete repair and convalescence is equally important. It is of the utmost consequence that a patient who has gone through the confinement and the mental anxiety inseparable from so important an operation as that for cataract, should at the earliest possible period enjoy the invigorating influence of change of air; and nothing tends so much to prolong that condition of chronic ophthalmia, which sometimes follows extraction, as too long a confinement to the sick-room. A few days of careful exposure to the fresh air during genial weather equally improves the eye and the patient's general health. It is, therefore, of importance so to time the operation that the period of convalescence may coincide with the finer season of the year; and this can only be done by choosing the spring and early summer for the operation: April, May, and June are, therefore, the best months to select for extraction, although the later summer months may be chosen, provided the weather be not sultry and oppressive.

RECTILINEAR EXTRACTION.*

This operation is, as I have already observed, a modification of that invented by Gibson.† He advised that *soft* cataracts should be freely broken up with a needle, and that after inflammation had subsided—in three or four weeks—a small incision should be made in the cornea, and the broken-up lens removed with a scoop. As the true principles which regulate absorption of a cataract in its natural position, when its tissue has been carefully broken into with a needle, became better understood, Gibson's operation fell into disuse. The fallacy of his procedure was revealed by the words 'after inflammation had subsided.' If by breaking up all the lens at once inflammation was set up, the proper practice would have been at once to evacuate the lens-matter which was the cause of the inflammation. Either do this, or adopt the slower, but safe course of only disintegrating the lens sufficiently to induce the absorbing process, without throwing the bulk of it into the anterior chamber all at once.

Graefe's operation ‡ was the following. After having dilated the pupil with atropine, he made a straight vertical incision, two, two and a half, or three lines long, through the cornea, not at its margin, but about a line nearer its centre. Such a 'linear' wound, he remarked, would heal more readily than a flap wound, and would involve less risk of *prolapsus iridis*. But, on the other hand, a rectilinear wound does not gape, and it therefore requires more manipulation to evacuate the pulpy lens-matter. Through the wound he passed in a small fleam-shaped cystitome, and with it broke up the capsule and the substance of the softened lens. Then a scoop was introduced into the midst of the pulpy mass, the wound was made to gape, by pressing the instrument against its edge, and the broken-up lens-matter escaped along the groove.

'Linear extraction' was not proposed by Graefe as a substitute for the older flap operation. He considered it to be specially suitable to cases of fluid lens, the corneal wound being made about two lines long; or when the lens was almost of a pulpy consistence, rather a longer incision being then required. When the lens had retained the normal consistence of adult life, and still more when in old age it had acquired increased hardness, he considered the operation contra-indicated.

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* I have taken the liberty of using the word 'rectilinear,' instead of 'linear' (the term by which Graefe designated his operation), because the wound made in the cornea is a straight one, in contradistinction to that of a flap extraction, which also forms a line, but a curved one.

† *Practical Observations on an Artificial Pupil, with remarks on the Extraction of Soft Cataracts*, 1811.

‡ *Archiv für Ophthalmologie*, ii. 217, 1855.

In consequence of these limitations of the operation being disregarded, and its being applied to cases of firm cataract, it soon fell into discredit. I knew of many eyes being lost after linear extraction which, from the skill of the operators, I have no doubt would have been saved if treated by them on the slow but safe plan of solution *in situ*, or by flap extraction.

Removal of cataract by suction.—In 1847 Laugier announced a quick and easy method of removing softened cataracts by suction; 'par aspiration,' as he termed it. He thrust a sort of cannula through the sclerotic into the substance of the lens, and then professed to draw out the contents of the capsule by means of a piston.* A less dangerous mode of operating was soon afterwards proposed by Blanchet, who employed a cannula and syringe somewhat similar to Laugier's, but with the much safer modification of introducing the cannula through a wound in the cornea. Suction fell into disuse, until it was revived, under a much more delicate and skilful form, by Teale,† in 1863. With two needles he tore up the capsule; then made a small wound in the cornea, through which he introduced a flattened cannula, or curette, into the body of the lens. A flexible tube attached to the curette terminated at the other end in a mouthpiece, and the operator gently sucked out the softened lens-matter. A syringe has sometimes been substituted for the tube. The reader will at once see that this must needs be a very delicate proceeding, and that if a too great power of suction be employed, serious mischief to various tissues of the eye may ensue.

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* *Annales d'Oculistique*, vol. xvii. p. 29. Laugier's operation gave occasion to a paper war, which soon grew into formidable proportions. First he was charged with having plagiarised his operation from some Italian surgeon; then an angry combatant declared that the Italian was himself but a plagiarist, and had been anticipated by the Arabians of the middle ages. Overlooking the fact that the Arabians did not know what a cataract was, nor where it was, their modern champion quoted Arabic and even Hebrew to prove their claims to priority of discovery. (See *Annales*, vols. xvii. xviii. xx. and xxiv.)

† *Ophthalmic Hospital Reports*, vol. iv. p. 197.

However applicable to the cataracts of adults suction may prove to be, it is quite uncalled for in the congenital cataracts of infants. As I have already observed (p. 171) a lens freely broken up, and even to a considerable extent displaced into the anterior chamber, does not at that early age set up irritation; and in a few months every trace becomes absorbed and disappears.

SCOOP EXTRACTION.

In many cases of cataract it is impossible to determine absolutely to what extent the softening process may have extended, and what amount of hard nucleus may still remain. It often happened, therefore, that the surgeon who had commenced the rectilinear operation in the belief that the whole lens was pulpy, found himself embarrassed by a firm nucleus of considerable size. The removal of this mass required so much mechanical interference, that the iris became bruised and injured, and also fragments of lens might remain behind the iris and set up the most serious irritation. These and other complications seem to have led Graefe to devise a mode of operation whereby the iris might be saved from injurious pressure, and at the same time additional room might be made for removing even a firm nucleus through a corneal wound smaller than that made in an ordinary flap extraction. The result of these attempts was the operation of scoop extraction.

And here I would observe that, whatever may be the final verdict which, after more extended experience, may await the operation of scoop extraction, its invention is wholly due to Graefe, who to a great degree has been deprived of the merit of having originated it.*

There is no doubt that one of the chief causes of failure after a well-performed flap extraction, is the occurrence of prolapsus iridis, and by the iridectomy proposed by Graefe all possibility of this was of course avoided. At the same time ample room was made for the removal of a large and solid nucleus, and through a less gaping wound than the crescentic incision of flap extraction. By the use of a scoop to draw out the nucleus, all pressure on the globe was rendered unnecessary.

Scoop extraction seems most suitable to those cataracts which are in an intermediate condition between the semi-fluid state which admits of a complete evacuation through a rectilinear incision, and the hardness of those in which little or no superficial change has taken place.

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* The operation was very fully described by him in the fifth volume of the *Archiv für Ophthalmologie*, pp. 158–173, 1859.

From the diminished risk of escape of vitreous humour, during scoop extraction, in consequence of the smaller corneal wound and the absence of pressure on the globe, the vomiting which so often follows the use of chloroform is of less consequence than in flap extraction; and therefore it may be administered in operations with the scoop, although in very quiet patients it may not be necessary.

The lids being well separated with a spring speculum, the surgeon fixes the globe, by nipping up a fold of ocular conjunctiva below the cornea. He then passes in a lance-knife at the upper edge of the cornea close to its junction with the sclerotic.* Next a forceps is passed in at the wound, a portion of iris seized, drawn out, and cut off. The cystitome is then used to lacerate the anterior capsule, which should be done to the full extent of the now enlarged pupil. Lastly, the scoop is insinuated behind the upper edge of the nucleus, and carried on until the beak of the instrument has passed just beyond the lower edge. The entire nucleus is then gently drawn out.

This sliding of the scoop behind the lens is the act of the operation which requires the most care, for by rudely thrusting the instrument too much backwards, its point might be made to break through into the vitreous humour. The surgeon must bear in mind the convexity of the hinder face of the lens, and give to the beak of the scoop a corresponding curved sweep.

It will depend upon the degree of softening which the surface of the lens has undergone, how much pulpy lens-matter will remain behind after the nucleus has been drawn out. As much of this pulp as can be got away without risk of breaking into the vitreous humour should be removed; but provided no solid nodules remain, the surgeon need not be over anxious to get out every particle of soft matter. Each re-introduction of the scoop, tends in some degree to irritate the edges of the corneal wound, and there is always the risk I have adverted to of breaking through with the instrument into the vitreous humour.

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* In his first description of the operation, Graefe advised that the cornea should be incised at its outer edge; but the deformity, and other disadvantages resulting from an over large and misshapen pupil, are better obviated by making the incision upwards.

The corneal incision being left clear of any lens-matter, the bandage may be applied over both eyes, as after flap extraction.

On examining the eye for the first time, the surgeon will sometimes find that the whole, or nearly the whole, of the enlarged pupil is filled with a flocculent or pulpy mass; but provided the wound be united, and the cornea clear, this obstruction of the pupil need not disquiet him. All will in time become absorbed, or if any considerable quantity should eventually remain, it may be cleared away by the aid of two needles, used in the manner hereafter described.

In most cases the softened periphery of the lens is sufficiently opaque to be readily seen at the time of the operation; but it is sometimes so nearly transparent as to be very difficult of detection, and it only becomes opaque and strikingly visible two or three days afterwards.

Although, from what I have said, it will be seen that the two great accidents which attend or follow flap extraction, loss of vitreous humour and prolapsus iridis, may be evaded by a carefully performed scoop operation, let not the reader suppose that the latter mode is to be regarded as 'extraction made easy,' or that success is always to be looked for. Cases occur in which, after the most careful scoop extraction, infiltration and softening of the cornea take place; or a more chronic form of irritation ends in permanent opacity of a large portion.

Graefe's scoop operation with iridectomy has undergone several modifications. One consists in first performing iridectomy, then waiting till the corneal wound is healed, and the anterior chamber restored; and then, by a second operation, removing the cataract with the scoop.

Another modification is as follows. A crescentic incision of the cornea is made, and the lens removed, as in ordinary flap extraction. A forceps being then passed in at the wound, the iris is seized, drawn out, and cut off, just as in the operation for glaucoma; the whole being done while the patient is under chloroform.*

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* As much of the success of the scoop operation depends on the form of the instrument itself, I must bear testimony to the superiority of that invented by Mr. Critchett, to which he has given the name of 'vectis.' (*Ophthalmic Hospital Reports*, iv. 315, 1865.)

MODIFIED FLAP EXTRACTION.

This operation, the latest form of extraction that has emanated from the fertile invention of Graefe, has hardly yet acquired a settled name. It is frequently called 'modified linear extraction;' but inasmuch as a considerable incision is made in the cornea, and the lens is brought out entire, by being pressed through the wound, the procedure certainly bears more resemblance to a flap extraction than either to the 'linear' or the 'scoop' modification.

The patient is brought under the influence of chloroform; the lids are separated with a speculum; and the eyeball is steadied by nipping up with a forceps a fold of conjunctiva below the cornea. The knife, which is long and very narrow, is made to pierce the sclerotic at about the distance of a third of a line from its junction with the upper and outer part of the cornea, so that the instrument, as it is thrust on, enters the anterior chamber quite at its re-entering angle. Having got the point clear into the chamber, the surgeon thrusts it on for a short distance downwards and inwards, then lowers the knife into a horizontal position, and brings the point out in the sclerotic at a spot opposite to that of its entrance; the edge of the knife, which had been kept upwards, is now to be turned a little forwards, and the corneal section completed. The wound now lies under the still undivided conjunctiva; this is then cut through with the knife, so as to leave a little flap of the membrane loosely covering the wound.

The next step of the operation is to remove the upper part of the iris with forceps and scissors, to such an extent as may seem desirable; then all the anterior capsule is freely lacerated with the cystitome. Next the curette is to be laid upon the lower part of the cornea, and pressed in a direction upwards and backwards, so as to induce the upper edge of the lens to present at the section, and as the lens slowly advances, its egress is to be aided by the curette being steadily carried upwards, with gentle pressure, over the surface of the cornea; and if portions of the soft periphery of the cataract become detached, they are to be helped on in their upward course by repeating the gliding pressure with the curette. To prevent the epithelial surface of the cornea from being abraded during these movements of pressure, Graefe advises that the curette should be made of vulcanite instead of silver.

EXTRACTION THROUGH THE SCLEROTIC.

I allude to this operation simply because it is mentioned in works on ophthalmic surgery. Those who first suggested it were misled by the apparent advantages of making a wound which would avoid any interference with either the cornea or the iris; but they overlooked the far more serious injury the eye must sustain from a large incision in the sclerotic and choroid, extensive loss of vitreous humour, and the introduction of instruments for seizing and dragging out the lens. The history of the operation is little more than a history of destroyed eyes; and those who wish to satisfy themselves on this point may refer to the cases quoted by Mackenzie in his *Practical Treatise* (4th edition, 1854, p. 812).

OPERATIONS ON OPAQUE CAPSULE.

I have elsewhere alluded to the statements of Stellwag and others respecting the so-called opacities of the capsule (p. 148). Surgically speaking, it matters not whether the capsule, which remains in the pupil after various forms of cataract operations, be in its very substance opaque, or whether it be only coated with opaque material. It obstructs vision, and must be removed.

After the lens has been got rid of by solution, the anterior and posterior portions of the capsule which have been broken through at the centre, retract, and form a white ring, which is often wholly concealed when the iris is in its natural condition, only becoming visible when the pupil has been artificially dilated. Sometimes a band or two may stretch across the pupillary area.

After extraction also, it commonly happens that the shreds of torn capsule form a delicate film, blocking up the pupil; and if any slight degree of iritis has followed the operation, this film may be made additionally dense and visible by exudation of lymph. Even when the area of the pupil looks black and clear, some months after extraction, the surgeon should endeavour to keep the patient in view; for perhaps at the end of a year or so a filmy membrane will be found stretching across the pupil, so delicate as to be detected only after the closest scrutiny, and with the aid of concentrated light; and yet the existence of this film will just prevent the patient being able to read. Short of this point all objects may be seen well, and yet, for want of tact and care in detecting this slight obstruction to vision, the surgeon may lose the credit and the satisfaction of having performed a first-rate operation.

In some instances, the film, which forms many months after extraction, appears to be produced by an opacity of the hyaloid membrane advancing towards the plane of the pupil after the lens and its capsule have been removed.

There are no manipulations which demand more judgment and care than those for removing capsular obstructions. The two chief points to be observed are: to make the aperture in the capsule central, so that it may correspond to the axis of vision; and to avoid isolating any portions by completely detaching them from the rest of the membrane. Loose shreds, when set floating by unskilful management, are ever afterwards a source of annoyance to the patient. Above all, the division of the capsule is to be made with the least possible disturbance of the vitreous body.

Every movement of the needle should have a definite object. It is useless to make random stabs and plunges at detached portions of capsule, in the hope of depressing them by some lucky hit; for their buoyancy will almost always cause them to return to their former position as soon as the needle is withdrawn. Delicate bands, tightly stretched across the pupil, may be divided in the middle, and then each half will retract towards its fixed point, and leave the interval free.

When a single needle is employed to tear through a portion of capsule, it sometimes happens that the delicate membrane yields and stretches, instead of being torn, and, after each attempt, the surgeon is mortified at seeing it return to its former position. It is in such cases that it is so efficacious to use two needles at once, as suggested by Bowman.* There is hardly any filmy expansion, or hair-like band, that may not by this means be divided.

The lids being held apart with a spring speculum, the surgeon has both hands at liberty, and he separately introduces the needles through the cornea, until their points reach the area of the pupil. He then, according to the nature of the obstruction, either makes in the centre of the opaque membrane a small hole, and then enlarges it by drawing the points of the needles in opposite directions, or cuts, twists, or tears through some band or filament which had been holding together the margins of the pupil.

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* *Medico-Chirurgical Transactions,* 1853, vol. xxxvi. p. 315.

If the rules which I have said should guide the surgeon in effecting the absorption of a cataract be strictly adhered to, namely, to attack the lens at the centre, always working the needle steadily from that point towards the circumference, and to be satisfied with slow progress, without attempting to break up a large mass of lens at the earlier operations; and if he carefully avoids isolating and setting loose any portions of capsule—he will rarely find it necessary to employ any other instruments than needles for obtaining a perfectly clear pupil.

But if a case has already been unskilfully operated on, and the needle used roughly and without any settled aim, it may happen that the entire capsule containing some small remains of white lens-matter has become crumpled up and rolled into an opaque mass, which is either moored in the midst of the pupil by two or three delicate bands, or is attached by a single filament, which allows the mass of capsule to float and sway to and fro with every movement of the eye. In such a case the entire mass of capsule must be extracted.

To effect this, an incision of suitable size is to be made through the cornea near its edge, and a forceps introduced, the points being kept closed until they have reached the capsule. This is then seized, and withdrawn by gentle traction, sufficient to make the retaining filaments give way.

The forceps used for this purpose must be so constructed that, when its points are separated, the iris will not fall between them. The cannula-forceps best fulfils this indication.

Far from having described in the foregoing pages all the operations which have hitherto been devised for the removal of cataract, my narrow limits, and still more a distaste for being a mere chronicler of minute differences of procedure, or abortive attempts at originality, have combined to limit my descriptions to those operations which have been approved of and practised by leading surgical authorities, or which have in some degree secured a reputation by retaining for a considerable period the confidence of the profession. A full account of all the cataract operations invented up to the present time, with a criticism of their relative value would form a work almost as large as my present essay. I cannot, however, dismiss this most important subject of cataract without a few observations on the relative merits of the operations which are practised for its cure.

For cataract in children and young persons, solution of the lens by keratonyxis, if performed with the careful precautions mentioned at p. 169, appears to me to be a nearly perfect operation. The natural curve of the cornea is preserved; the pupil remains central; in short, all the structures of the globe are left, practically speaking, in their natural conditions, except that the offending lens is gone. The treatment, it is true, extends over several months, although in infants I have seen all the lens absorbed at the end of a few weeks. But even to a young adult, what is the delay of several months, nay, in extreme cases of enforced caution in operating, what is the delay of a year, when good and lasting sight is eventually gained, compared with the patient's loss, when the surgeon, for the sake of a rapid cure, by his over-manipulation or his dangerous activity, calls up destructive inflammation in the eye he was anxious to save?

Sometimes in the course of the most careful treatment by solution, a sudden disruption and displacement of the whole lens occurs; nothing but an immediate incision of the cornea, and removal of the irritating lens-matter, will then save the eye; but this accident seldom happens if proper precautions have been taken from the first.

With regard to extraction, all surgeons, I think, are agreed that, *provided all goes well*, the final result of a good flap operation is superior to that of any other procedure. In an eye where all the tissues are sound except the lens, such an operation skilfully performed, with careful after-treatment until the cure is completed, is a real triumph of surgery, only to be surpassed, perhaps, by the result of an equally perfect operation by solution. But then comes the all-important question, Is all as likely to go well with the ordinary flap extraction as with some of its modifications, or with the scoop operation?

The one great source of trouble after a flap operation is prolapsus iridis. The surgeon may have done his part perfectly, his last look at the eye, before he puts on the bandage, may show him the iris in its proper position, with the pupil central, and the corneal wound in the closest apposition. For three or four days after the operation, the patient may be quite comfortable, and the eye hardly complained of; and yet when the surgeon makes his first examination, he may find the section gaping, plugged with a mass of iris, the pupil displaced, or even drawn into the wound. Speedy cure or a shapely eye are henceforth unattainable; and the operator must be content if the cornea retains its transparency, and the other tissues are not too far injured by tedious inflammation to allow of sight being ultimately restored by the formation of an artificial pupil.

I know that many surgeons, in discussing the perils incident to flap extraction, would put forward, as one of the greatest sources of danger, the largeness of the corneal wound, as involving loss of vitality in the flap or a slow process of opacity in it. But I do not think that either of these disasters is often caused by the mere length of the incision; and, on the other hand, a free opening in the cornea allows the lens to escape without bruising the edges of the wound, and, what is of still more importance, without leaving behind it any considerable fragments of its cortical portion. Now this latter circumstance is inseparable from every case in which a lens is forced to squeeze itself out through a small aperture. In doing so it must scrape off more or less of its substance, and either these fragments remain, to set up irritation in the iris, or to insinuate themselves into the wound, and interfere with its quick union; or else they are removed by too much surgical interference, too frequent introduction of a scoop, or a suction-curette, or a syringe, or by too much squeezing and pressing of the eyeball. Overmuch manipulation of the eye is, I think, the radical fault both of the modified flap extraction and of the scoop extraction, and, indeed, of most of the attempted improvements of the flap operation.

As for loss of vitreous humour, which, without the slightest fault of the surgeon, sometimes takes place as soon as the corneal flap-wound is completed, it is equally liable to occur during scoop extraction, if the scoop is allowed to pass too deeply backwards, behind the lens, so as to rupture the hyaloid membrane; and an escape is still more probable during the squeezing and pressure which are inseparable from Graefe's modified flap operation.

In giving a preference to the older flap operation, as being, *upon the whole*, preferable to the other forms of extraction, I am quite aware how much I am influenced by the fact of my having been accustomed to the constant performance of the former operation for a period of nearly twenty years before any modification of it was invented. When I tried the scoop operation in cases which appeared to be especially suitable for it, I found that while the most successful cases left the patient with a deformed and enlarged pupil, and with the optical annoyance of circles of dispersion, inseparable from that condition, I had in less favourable instances to contend with chronic opacity, insidiously invading the cornea, in patients whom I had selected for scoop operation in consequence of feeble reparative powers, which seemed to render dangerous the larger wound of a flap extraction.

In 1834, a celebrated surgeon of that day wrote an essay, '*On the certainty and safety with which the operation for the extraction of a cataract from the human eye may be performed.*' Nine years later another surgeon announced '*An easy mode of dividing the cornea in extraction.*' But in spite of these and other similar assurances—which were by no means borne out by the success of the gentlemen who published them—the really experienced and candid operator will confess that 'extraction made easy' is still an undiscovered boon.

Every modification which has as yet been devised has some especial difficulty or danger. Only those who have had large opportunities of operating, and also of watching the results of the operations of others, can attain to a true estimate of the good and bad points in any given mode of treatment. Published statistical reports only mislead. To class cataract operations as 'successful' and 'unsuccessful' may please the public, but cannot afford real information to the honest and thoughtful practitioner. In general surgery, indeed, many of the most important operations may be thus abruptly divided. In classifying operations for ovarian disease, for instance, we are certain that the growth if left to itself will destroy the patient. If the tumour has been removed, and the patient restored to health, the operation has been successful. If, in consequence of the operation for removal, the patient has died, the operation was unsuccessful. So with the removal of a malignant growth—of a crushed limb—of a stone in the bladder, &c., every one can appreciate the classification of such cases into 'successful' and 'unsuccessful.' But a successful operation for cataract, What is it? The mere removal of the opaque lens from the eye may be put down by one man as a success. The recovery of a patient with such an amount of sight as enables him to guide himself, is the success of another man. A third is satisfied if his patient can read a few large letters; while a fourth, with a higher standard of excellence, will accept nothing as success short of his patients reading fluently a small type, and seeing distant objects with almost normal distinctness.

Then there is the professor who is so overwhelmed with the work of his clinique, that he must content himself with doing his operations as well as he can, not having the time, even if he had the inclination, to follow up his cases, and ascertain for himself their ultimate result. Of what value can his statistics be?

The 'pious frauds' of charity-committees, who hope, by startling reports of successful cases, to attract fresh subscriptions for the good of their institution, are not to be judged by a scientific standard. Such appeals are addressed to the general public, and are of no interest to the profession.

CHAPTER X.

GLAUCOMA.

'GLAUCOMA' is a term which in process of time has acquired a meaning quite different from that originally conveyed by it. Among the ancients 'glaucoma' signified opacity of the lens, and was therefore regarded by them as a wholly incurable disease, inasmuch as to remove the lens from its position would have been deemed equivalent to displacing the very seat of sight. At a later period the etymology of the word caused it to be applied to many cases of greatly impaired or lost vision attended with fixed dilatation of the pupil; for, in such cases, the change of colour which the lens naturally undergoes in old age, and some slight diminution of its transparency, combined to impart to the light reflected from the fundus of the eye a greyish or drab colour, which, in descriptions, was exaggerated into green; and much labour was expended by ophthalmic writers, not many years ago, in attempts to explain the cause of this so-called green or *glaucous* tint. In fact, the dull greyish reflex, upon which so much stress was formerly laid, may be perceived, whenever the pupils are dilated, in the eyes of almost any old person whose lenses are beginning to be cloudy.

The word 'glaucoma' has now come to be used—without any reference to its etymology, and in a purely arbitrary sense—to signify a disease gradually involving the most important tissues of the eyeball, and, if left to itself, ending in total blindness.

It is only since Graefe drew special attention to the subject, that the important *premonitory symptoms* of glaucoma have been estimated at their true value. Long before his time, the more advanced stage of glaucoma, and especially the strongly marked and unmistakeable outward appearances of the disease in its complete form, were perfectly familiar to the profession; but the connection between this hopeless form of blindness and an earlier stage of inflammatory action was not understood; and the merit of explaining this connection, of showing how inevitably changes, apparently of no extreme urgency, lead the way to incurable loss of sight—above all, the invention of operative means for arresting these changes, and restoring the eye to usefulness—all this merit belongs to Graefe.

I will first notice the appearances of glaucoma in its complete stage.

The patients are beyond the middle period of life.

They are usually pale and unhealthy in appearance, often showing that worn expression which becomes impressed on persons who have gone through much suffering.

The eyeball, instead of having the slight degree of elasticity natural to it in health, is remarkably hard, giving to the finger almost the sensation of a stone.

The sclerotic, often marked with faint dusky patches, is traversed by large, purple, tortuous veins, which emerge abruptly, close to the margin of the cornea. Sometimes there is also a slightly-marked vascular zone.

The cornea, although it may be sufficiently transparent to allow of the iris being well seen, presents a peculiar unevenness of its epithelial surface; so that the lines of a window-frame, instead of being distinctly depicted on the corneal surface, appear wavy and irregular: and the reflected light is dull, like that from a slightly steamy glass. In some cases the cornea is hazy throughout its substance, and occasionally the epithelium is found vesicated in small patches.

If the state of the cornea allows a good view of the iris, these two structures will usually be found in close approximation to each other, the pupil being dilated to its fullest extent; sometimes the pupil is less dilated, but irregular. The change in the appearance of the iris is very characteristic. Its sharply-defined fibrous character is lost, and it assumes a peculiar *slate-colour*. Sometimes the veins of the iris are sufficiently enlarged to be distinctly visible to the naked eye.

The lens advances very near to the cornea, and in cases of old standing is opaque. Sometimes this opacity has a milky appearance, with slight indications of striæ, and the whole lens looks full and swollen, as if it had undergone maceration, and were about to burst its capsule. Occasionally the divisions between the planes of lens-fibres are very distinctly seen. The lens may vary much in colour, appearing greyish or greenish drab, dirty yellow, or dull orange.

Perception of objects is wholly lost; sometimes even, all perception of light.

An eye may present all the above-mentioned appearances in consequence of slow disease, advancing, with intervals of quiescence, during months or even years; or, on the other hand, the same appearances may be the result of an acute inflammatory attack, coming on in the most sudden manner, and within a few days producing all the changes above noticed, with the exception of the opacity of the lens, which takes place more slowly.

Mere inspection of an eye in which glaucoma is complete will not enable the surgeon to decide whether the morbid changes have been the result of the *chronic* or the *acute* form of the disease.

I have already alluded to the merit of Graefe, in having been the first to connect that well-known incurable condition of the eye, to which alone the term glaucoma was formerly applied, with a definite train of premonitory symptoms, marking a period during which surgical treatment might be of service. These peculiar premonitory symptoms consist in intermittent attacks of dimness of sight. A patient perhaps sees well up to the middle of the day, then objects appear as if involved in smoke, and reading becomes difficult or impossible. This dimness may last for the rest of the day, and the next morning it may have quite passed off, to return again in the course of a few hours. This intermittent dimness may go on for months, with little, if any, external appearance of inflammation; in other cases, the onset of dimness is attended with slight redness and watering of the eyes. In fact, unless the peculiar premonitory symptoms of incipient glaucoma are well understood, a case of the most serious kind may be lightly regarded as one of unimportant catarrhal ophthalmia.

A luminous object, as a candle or a lamp, appears surrounded with a halo of prismatic colours. The iris approaches the cornea, and the pupil is inactive, although perhaps not dilated; and, unless the attack be very slight, the surface of the cornea, instead of presenting a brilliant mirror-like smoothness, will appear slightly dull, like a glass that has been breathed upon; so that the lines of the window-frames will be reflected in a faint and wavy form. This uneven and dull appearance of the corneal epithelium is a very valuable diagnostic mark in all stages of glaucomatous disease, and will often arouse the suspicions of a careful observer in cases which might otherwise be thought unimportant. It is invariably present in all advanced and confirmed cases of glaucoma. The premonitory obscurations may persist for weeks, with occasional interruptions, even for months; and patients may be liable to intermittent attacks for a year or more, before any outburst of acute inflammation occurs. Neuralgia in the ophthalmic division of the fifth nerve, is commonly added to the other premonitory symptoms.

If the eyeball be carefully examined during any period of glaucomatous disease, it will be found in some degree harder than natural. This hardness goes on increasing, until, in the last stage of glaucoma, the globe feels almost like a ball of stone.

I know of no instance in which the *tactus eruditus* of the surgeon is more severely tested, than in examining some of these incipient cases of glaucoma. The same eyeball may suggest to two able examiners different degrees of hardness, or they may even disagree as to whether the eye be abnormally hard at all.

While the patient gently closes the lids, the surgeon is carefully to apply the tips of his fingers upon the upper part of the globe, lightly pressing upon its coats. And again, when the patient opens the lids and looks upwards, the surgeon presses the middle part of the lower tarsus steadily against the sclerotic, just below the cornea, and carefully notes the degree of resistance he meets with. I need hardly say that too great softness of the globe is as much a mark of disease as too great hardness, and that, to discriminate truly between the various degrees of what is too hard and what is too soft, the surgeon must familiarise himself with the exact amount of firmness and elasticity indicative of a sound state of the coats and humours of the globe, by means of that careful fingering which repeated practice alone can give.

Donders and others have devised formulæ for noting down the amount of tension existing in the globe, but the gradations are so manifold, that it is barely possible to tabulate them correctly according to any fixed plan.

Rest of the eyes, careful attention to general health, and iodide of potassium internally, I have found to constitute the best mode of treatment in this stage; but the patient must be warned as to the true significance of the symptoms, and as to the probable onset eventually of acute glaucoma.

It was to the ophthalmoscopic appearance of the optic nerve and its vessels, in all stages of glaucomatous disease, that Graefe drew such special attention. In well-marked cases the optic nerve appears concave, and the retinal vessels, instead of passing off from their point of emergence in a straight direction, to ramify on the retina, begin by curving over the edge of the cup-like depression at the end of the nerve.* Very slight pressure on the globe with the finger causes visible pulsation in the retinal vessels; or this pulsation may exist without external pressure.

In the slowly-advancing early stage of glaucomatous disease, the depression of the optic nerve may be so trifling as to escape observation; but in confirmed cases it is very marked. When the disease has come to a crisis, and acute glaucoma has set in, the details of the optic nerve and retina cannot be seen with the ophthalmoscope, owing, I believe, in great part to the condition of the corneal surface, which produces irregular refraction of the rays of light. In the advanced stage of glaucoma a dull red glow is sometimes all that can be seen.

As disease goes on, the dimness of sight, instead of being intermittent, becomes permanent, and the field of vision gradually contracts, so that at last the patient in viewing objects seems to be looking at them through a small hole in a screen. Sometimes, however, this narrowing of the field of vision does not take place, the dimness being pretty uniformly diffused. By this time other marked changes have taken place in the globe. It has acquired a peculiar stony hardness; the veins on the sclerotic emerge abruptly near the edge of the cornea as thick purple trunks; the pupil gradually dilates until in old cases the iris almost disappears, acquiring at the same time a peculiar slaty tint. Eventually the veins of the iris enlarge, and are especially noticeable as a ring-like plexus near the pupillary margin. The lens at last becomes opaque, milky-looking, and indistinctly striated; it is often of a greyish drab, dirty yellow, or dull orange, and marked with earthy streaks and patches. Its threefold division is often very well marked, as if by undergoing maceration in water, it had swollen up and were about to burst its capsule. By this time even perception of light is usually quite lost.

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* Plate I. fig. 2. This is a diagram, not a drawing from an individual case. It shows, in a rough way, the abrupt curve of the vessels, the concave form of the optic disk, and the grey tint which the latter sometimes assumes in the very advanced stage of true glaucoma, or of grey atrophy of the optic nerve.

From what I have already stated as to the various changes in glaucoma, it will be understood that it is by a careful comparison and estimate of several morbid appearances taken together, that the disease is to be discriminated, and not by the presence of any one distinctive sign. If mere abnormal hardness of the globe be assumed as the proof of glaucomatous change, several forms of inflammation and degeneration quite distinct from glaucoma may be mistaken for that disease. A 'cupped' condition of the optic nerve may simply be the result of chronic wasting. Coloured halos around luminous objects are commonly associated with ordinary catarrhal ophthalmia. But let all these symptoms co-exist;—intermittent obscuration of vision, prismatic halos, fixity of the pupil, increased hardness of the globe, a changed condition of corneal epithelium, cupping of the optic nerve — and the diagnosis becomes an absolute certainty.

I have said that the course of the glaucomatous process is usually more or less gradual, a longer or shorter premonitory stage preceding the onset of an acute attack; but this sometimes comes on suddenly, frequently in the night, the patient having gone to bed apparently well, and being aroused from sleep by intense neuralgic pain to find himself all but blind. When such an attack occurs, on account of the hazy condition of the corneal epithelium, or some change in the vitreous body, or from both causes combined, the optic nerve and retina cannot be discerned, and the ophthalmoscope only reveals a dull red glow from the fundus.

Treatment of glaucoma.—While cases of chronic glaucoma which had advanced to their last stage were abandoned as wholly incurable, and beyond all treatment; those of the acute form (under the name of *ophthalmitis interna, ophthalmitis arthritica*, &c.) were formerly treated on antiphlogistic principles, pushed to the severest extremes; profuse bleeding, both local and general, and mercury in salivating doses, being the common means employed to check the progress of disease. Some practitioners regarded gout as the primary cause, and, in addition to depletion, employed colchicum, or other anti-arthritics.

In spite of every form of treatment, glaucoma remained the *opprobrium* of ophthalmic medicine; and the announcement, therefore, of its curability by means of an operation at once attracted general attention. In 1857 Graefe* published an account of this operation of 'Iridectomy,' and he also brought the subject before the Ophthalmological Congress which met at Brussels in that year. An incision was to be made through the cornea, close to the sclerotic; a considerable portion of the iris was then to be grasped with a forceps, drawn out, and cut off. By this operation the 'intraocular pressure,' which was the cause of all the phenomena of glaucoma, would at once be removed.

His operation is performed as follows. The globe having been fixed with a forceps, a lance-knife is passed obliquely through the sclerotic, about a line and a half from the spot where it blends with the cornea, so as to make a wound penetrating into the anterior chamber. An iris-forceps is then passed through the wound, a fold of iris seized, drawn out, and then cut off close to its ciliary attachment. Graefe and others lay particular stress upon the iris being removed quite up to this point, but I do not believe it to be at all essential. I have always performed the operation with a Beer's knife, making, in fact, a corneal wound like the upper section for flap extraction, but on a much smaller scale. The wound is a good deal anterior to that recommended by Graefe, and passes through the true cornea, but close to its sclerotic union. The iris, consequently, is not divided quite up to its ciliary attachment; and yet I have found the result of the operation just as satisfactory as that first described. In acute glaucoma the lens always advances forwards, close up to the cornea, and is therefore endangered by the thrust made with the lance-knife; whereas, in using Beer's knife, in the way I have mentioned, its point is always kept in front of the iris as it lies against the projecting lens. It appears to me that if a peripheral portion of iris is removed, sufficient to establish a free communication between the anterior and posterior chambers of the aqueous humour, the object of the operation has been attained.*

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* See his essay in the *Archiv für Ophthalmologie* (vol. iii. p. 456), entitled, *On Iridectomy in Glaucoma, and on the Glaucomatous Process.* Also (vol. iv. p. 127, 1858), *Farther Clinical Remarks on Glaucoma, Glaucomatous Diseases, and the Curative Effects of Iridectomy.* These two essays, together with another, *On Coremorphosis as a Remedy in Iritis and Iridochorioiditis*, were translated, under slightly-changed titles, by Mr. J. Windsor, and published by the New Sydenham Society (vol. v. 1859).

Hancock has recommended the following operation in glaucoma, as being greatly preferable to iridectomy. The point of a cataract-knife is inserted at the lower and outer part of the edge of the cornea, and carried in a direction obliquely downwards, dividing the sclerotic to about the extent of two lines, and penetrating through the corpus ciliare into the vitreous humour. The incision also divides the attachment of the iris, and the delicate fibres constituting the 'ciliary muscle.' The division of these fibres, which I have already spoken of as chiefly constituting the apparatus for changing the form of the lens in the act of accommodation, is regarded by Hancock as the essential point of the operation, since he believes their spasmodic contraction to be the primary cause of the phenomena of glaucoma.

In performing the operation of iridectomy, great care must be taken to avoid wounding the lens, which, as I have said, always projects towards the cornea, and is sometimes in actual contact with it. This danger is avoided by making the corneal incision in the way I have recommended.

A good deal of blood usually flows from the cut iris into the anterior chamber, sometimes quite filling it. This blood soon becomes absorbed, if the eye is kept at rest, and bandaged with a carefully adjusted amount of pressure, for twenty-four hours. When, after this period, the eye is examined, the cornea is found to be clear, and the peculiar unevenness of its epithelial surface has given place to the normal mirror-like smoothness.

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* If this view be correct, the explanation which those who prefer Hancock's operation have offered, as accounting for the beneficial effect of iridectomy, becomes inconclusive. They consider that the unintentional division of the fibres of the ciliary muscle, during the performance of Graefe's operation, and not the removal of the piece of iris, constitutes its real value. But if iridectomy, performed in the way I have recommended, be found as effectual as when the iris is removed quite up to its ciliary attachment, it follows that division of the ciliary muscle can in no way contribute to the beneficial result of the operation.

The recovery of sight after a well-timed and well-performed iridectomy is most remarkable, in many cases almost amounting to the restoration of former good vision; but in other instances the patient is greatly annoyed by the dazzling appearance and the distortion of luminous bodies, the result of the over large pupil, and the consequent flooding of the eye with light. Tinted glasses, an opaque diaphragm perforated by a narrow transverse slit, either with or without a low convex glass, or other optical contrivances, must be resorted to according to the circumstances of the case. But even if, with all these appliances, the patient is still annoyed by irregular refraction, this comparatively trifling inconvenience is not to be put in comparison with the benefits of iridectomy, without which utter blindness must inevitably have closed the scene.

The precise rationale of iridectomy as a curative means still remains to be accounted for; and it must so remain until we become acquainted with the first origin of glaucoma. We speak, indeed, of the disease as consisting in 'intra-ocular pressure,' but why the fluid contents of the globe are in excess, so as to cause this pressure, is as yet unexplained. We must be satisfied practically to employ iridectomy, without being able to give any clear theoretical reason for our procedure.

SCROFULOUS AND MALIGNANT DEPOSITS WITHIN THE EYEBALL.

As the present treatise on Diseases of the Eye forms part of a general system of surgery, special sections of which describe the pathology of morbid growths, whether malignant or otherwise, I have not thought it necessary to go into the subject of such growths, in connection with the eye, except just so far as they have relation to diagnosis and treatment.

Scrofulous and encephaloid deposits, differing so essentially from each other in their histology, and in the ultimate effects they produce upon the eye, nevertheless present at a certain stage of their progress almost the same external appearances.

It is chiefly in infants and young children that encephaloid and scrofulous deposits take place, while melanosis is the form more commonly met with in adults.

In scrofulous and encephaloid cases, the first symptom noticed is a yellowish reflection from behind the pupil, having more or less of a metallic brilliancy, like that seen in a cat's eye. The surgeon will find it difficult to form a decided diagnosis at this early stage of the disease. The pupil for a time retains its mobility, and it will therefore be necessary to apply atropine before using the ophthalmoscope; the employment of which, I need hardly say, is often very difficult with timid or restless children.

The retina will be found thrust forwards as an irregularly lobulated mass, and enlarged vessels will be seen ramifying over the uneven surface. As disease advances, the pupil becomes dilated and fixed, so that the ophthalmoscope can be used without any previous application of atropine. The mass slowly advances until it almost touches the hinder surface of the lens, which, up to this period, retains its transparency. Hitherto the patient suffers little pain, there is hardly a trace of increased vascularity about the conjunctiva or sclerotic, and the general health appears little, if at all, affected.

In the second stage, however, both redness and pain set in. The lens becomes cloudy, so that the deposit at the fundus of the eye can no longer be recognised, except by the indistinct yellowish tint which it transmits through the lens. The sclerotic and conjunctiva become deeply injected, and, so soon as the lens begins to press against the cornea, there is a considerable flow of tears, with intolerance of light. The patient becomes restless and feverish, with loss of appetite and irregular action of the bowels. In this second stage, the eyeball becomes enlarged and the cornea opaque. The sclerotic bulges at one spot, as if matter were forming there, or it becomes soft and fluctuating in several places. Usually the softening is most marked just behind the upper margin of the cornea.

Up to this point it will have been difficult, if not impossible, for the most experienced surgeon to pronounce, with absolute certainty, whether the disease under his observation be scrofulous or encephaloid. In either case the sclerotic usually gives way at the most projecting spot, the humours escape, frequently the lens also, and, for a short period, pain ceases, and the patient's general health improves.

If the case be one of *scrofulous* deposit the disease may now begin to subside, the globe slowly wasting, until, eventually, a mere nodule remains at the bottom of the orbit. Indeed, in some scrofulous cases the globe does not burst at all; but, having become enlarged to a considerable extent, slowly begins to shrink, and at last undergoes atrophy. After destroying one eye, scrofulous disease will sometimes attack the other, with the same result.

But should the deposit be *encephaloid*, a farther change now begins. A soft vascular growth sprouts forth from the opening in the sclerotic, through which the humours of the eye had escaped. This fungous mass enlarges with great rapidity, frequently attaining an enormous size, and exudes a profuse fœtid sanies, which, by exposure to the air, dries into brownish crusts, giving to the tumour almost the appearance of a sponge. The separation of one of these crusts, or a very slight touch, often causes bleeding from the vessels which traverse the tumour in every direction. The patient becomes more emaciated and weak, and, after several months of suffering, dies, either from repeated loss of blood, or from the simultaneous development of malignant disease in the brain, or some other important organ.

Melanosis is the form of malignant disease which attacks the eye in adult life. Sometimes the melanoid deposit is so abundant that the whole mass acquires a brownish-black tint; in other instances it is only partially distributed through an encephaloid growth. Although more commonly commencing in an eye not previously diseased, melanosis sometimes attacks one which has already become useless from destructive inflammation.

It is between the choroid and retina that melanotic deposit most frequently takes place; and the visual power of a portion of the retina is often retained to a remarkable degree, while the rest of it has become completely displaced. The same remark holds good also in encephaloid cases. The ophthalmoscope is of course our only means for arriving at an accurate diagnosis of melanotic deposit within the vitreous chamber. When it has burst through the coats of the globe, its dark colour and general appearance would at once proclaim its real nature. Occasionally melanosis appears to originate outside the globe, in connection with the conjunctiva, subsequently involving the sclerotic and other tissues.

The medical *treatment* of encephaloid and melanotic deposits within the globe, as in other parts of the body, can be only palliative. We may lay it down as a rule in the treatment of such affections, that, while we know of no substance which can cure them, they may often be kept in check for a considerable time by supporting the general powers of the patient; and the more we are able to do this the slower will be the progress of the malignant growth, and the less tendency will it evince to involve the neighbouring tissues. Strict attention to the patient's diet, and to the regulation of his health by means of suitable tonic medicines and pure air, will often retard to a remarkable degree the fatal termination of the disease.

In endeavouring to form an opinion as to the curative results of *surgical operation* in malignant disease of the eyeball, we must altogether dismiss, as untrustworthy, the records of our older surgery. For many of the eyes said to have been removed without any return of disease were doubtless affected with scrofulous deposit, which, as I have said, at a certain stage of its progress, so closely resembles the encephaloid form. Removal of the eyeball should be undertaken only after the most careful examination, both local and general. The surgeon should inquire into the mode in which the various bodily functions are performed, so as to assure himself that no appreciable deposit of a malignant kind has taken place in any of the viscera. He must, as far as possible, ascertain that the encephaloid or melanotic mass is fairly enclosed within the fibrous case of the eye, without having involved the optic nerve, or penetrated through the sclerotic into the cavity of orbit. These conditions cannot be absolutely determined; but attention to certain points will help the surgeon to make some approximation towards a correct diagnosis. If the eyeball be thrust forwards, without its actual volume being increased—if it be habitually turned in any particular direction—if it be fixed, or only movable to a very slight degree—above all, if the point of the little finger passed backwards by the side of the globe, encounters any resisting mass within the orbit, it may fairly be assumed that the morbid deposit extends beyond the cavity of the eyeball; and in such a case its removal would be of doubtful success. Even under the most favourable circumstances the surgeon, when convinced of the existence of a malignant growth, would give a most guarded prognosis; for in no class of operations for the removal of such disease are the statistics more discouraging than in those relating to the eye.

CHAPTER XI.

DISEASES OF THE LACRYMAL APPARATUS.

The lacrymal apparatus comprises the lacrymal gland, which secretes the tears—the puncta and canaliculi, which convey them into the lacrymal sac, where they temporarily accumulate—and the lacrymo-nasal canal, whereby they are finally conveyed into the lower chamber of the nose.

If we consider the small calibre of the canaliculi we can readily understand that a very slight degree of thickening in the delicate membrane which lines them, or a trifling displacement of the puncta, can suffice to disarrange the mechanism of taking up and carrying on the tears; and accordingly we find that watering of the eye (*epiphora*) is a frequent symptom in various forms of conjunctival inflammation. It also constitutes of itself a troublesome condition, which is constantly being brought under the surgeon's notice.

If the puncta are quite impervious, of course the tears must trickle down the cheek as fast as they are secreted. A contraction or stricture of the puncta or canaliculi will cause a less complete overflow. If the lacrymo-nasal canal be strictured, or its outlet obstructed, the tears passing into the sac will accumulate there, and, together with the pent-up mucus, form a swelling termed *mucocele.* Unless relief is obtained, the distended sac becomes inflamed, and pus is formed, which eventually discharges itself through an opening in the skin, constituting true *fistula lacrymalis.* This term, however, is often incorrectly applied to abscess of the sac without any perforation of the skin.

When a case comes before us in which there is a continual watery state of the eye, our attention should be at once directed to the puncta. These apertures, in a healthy state, are in contact with the ocular conjunctiva, so that, to bring them into view, it is necessary to draw the margin of the tarsus a little away from the eyeball. If the conjunctiva lining the lower lid has become considerably thickened from chronic inflammation, the edge of the tarsus may be so much everted as to cause the punctum to face upwards, or even directly forwards. In such a position it can no longer take up the tears, which accordingly run over the edge of the lid. In extreme cases of *lippitudo* and chronic ophthalmia, the puncta, still retaining their natural position, are sometimes found to be so completely obliterated that their position can no longer be detected.

If the puncta are in their natural position, and their openings appear unobstructed, and yet no tears can be made to regurgitate through them when the point of the finger is firmly pressed against the lacrymal sac, just below the tendon of the orbicularis palpebrarum, we may suspect some stricture to exist in the canaliculi. We can ascertain this only by exploring them with a fine probe. This may seem to be a very simple matter; but it requires considerable care and tact, without which much serious mischief may result. The membrane lining the canals is extremely delicate, and any want of gentleness in passing the probe may tear the membrane, and so give rise to fresh obstruction. We must bear in mind the abrupt turn which the canal makes at a short distance from the punctum. In passing a probe into the lower canaliculus, the instrument should be directed almost vertically downwards for about half a line, and then turned inwards towards the nose, in which direction it will pass on, should no stricture exist, until its point strikes against the inner wall of the sac, where it lies against the bone. During the whole process of introducing the probe, the tarsi should be kept on the stretch, by drawing outwards the external canthus.

Except to a practised hand, it is often difficult to detect whether the point of the probe is arrested close to the junction of the canaliculus with the external wall of the sac, or whether the point has reached the internal wall. In the former case any onward pressure with the instrument produces a slight dragging of the tarsus; whereas contact of the probe with the inner wall of the sac not only conveys to the hand a peculiar feeling of firm resistance, but at once causes all movement of the tarsus to cease.

If the canaliculi be found free from stricture, and the sac forms a distinct prominence below the inner canthus, it is pretty certain there is an obstruction at the lacrymo-nasal canal. If this canal be perfectly closed, while the canaliculi are free, firm pressure of the finger on the swollen sac will cause its contents to escape at the puncta; but if the canal, although narrowed, be pervious, steady pressure in a direction downwards and a little backwards, may overcome the resistance of the stricture; the swelling then suddenly yields, and the contents of the sac pass into the nose.

When we consider that the membrane lining the outlet of the lacrymo-nasal canal is that common to the chambers of the nose, we cannot be surprised that catarrhal inflammation of this membrane should be a frequent cause of lacrymal obstruction. If pressure on the sac suffices to empty its contents into the nostril, the inconvenience of the partial obstruction at the outlet may be kept in check by the patient taking care frequently to make this pressure, and to use at the same time other means for restoring the lining membrane of the sac as well as that of the nose to a more healthy condition. But if this pressure is omitted, and the tears and mucus are allowed to collect and to distend the sac, this distension, under some attack of catarrhal inflammation, may suddenly transform the chronic disease into an acute one. Pain is then felt in the part; the lids become red and puffy,—sometimes assuming an erysipelatous appearance; and the patient is quite unable to separate the tarsi. The swollen sac feels hard to the touch, and even slight pressure on it is extremely painful, while it fails to press out any thing from the puncta.

These symptoms show that suppuration is taking place within the sac. If the case is left to itself, the pus escapes by bursting through the skin, and the opening frequently remains fistulous, allowing the tears, which have passed through the puncta into the sac, to trickle out upon the cheek, thus constituting a true *fistula lacrymalis.* After all inflammation has passed away, and the redness and swelling which attended the formation of the abscess have disappeared, the fistula often contracts to such a small aperture, that, were it not for the tears which slowly distil from it, the opening would hardly be perceptible. It is about the size of a pin-hole, and almost resembles one of the puncta in minuteness of aperture.

Treatment of lacrymal obstructions.—These obstructions, varying as they do from a slight thickening of some portion of the lining membrane of the sac or nasal canal, causing occasional watering of the eye, up to a total occlusion of the nasal canal, with displacement or stricture of the puncta and canaliculi, cannot of course all require the same kind of treatment. Slight cases of thickening of the lining membrane of the sac, if of recent date, may be much benefited by the repeated application of small oval blisters, about half an inch long, over the sac. Astringent solutions of alum or tannin may, at the same time, be dropped into the corner of the eye, so that they may follow the course of the tears, and thus reach the thickened membrane. This object may be facilitated by slitting up the canaliculus in the manner hereafter to be described. Each time the drops are used, the sac should be previously emptied, by pressing the point of the finger upon it in a downward direction. Should the lining membrane of the nose be in a thickened state, injections of astringent lotions into the nostril are of service; and in all cases attention to the general health and suitable tonic medicines are indicated.

Warm water-dressing should be applied whenever acute inflammation of the sac sets in with the symptoms I have described. This form of applying warmth and moisture is, in all affections of the lids and parts about the eye, to be preferred to poultices, as the latter frequently produce a troublesome form of eczematous eruption. Diligent application of water-dressing for four-and-twenty hours will frequently subdue acute inflammation of the sac to such an extent that not only do the redness and swelling of the lids disappear, but the thickening of the internal membrane gives way; so that gentle pressure over the sac suffices to empty its contents into the nose, and the case returns to its chronic condition. Should this not be the case, an incision must be made into the sac, and exit given to the pus.

There is hardly any form of local disease which has given rise to a greater variety of surgical treatment than chronic distension of the lacrymal sac, and stricture of its nasal duct. The distended sac has been compressed by an apparatus of pads, adjusted by means of springs and screws. The strictured sac or duct has been subjected to gradual dilatation by means of strings of catgut, introduced through an opening made into the sac, and brought out into the nostril; strings of increasing thickness being used as the canal would admit of their passage. Dilatation of the stricture was at one time attempted from below, by means of curved sounds, introduced into the sac from the nostril; but these instruments were difficult to introduce, there was great risk of breaking with them some of the fragile bones in the neighbourhood of the nasal duct, and they could not reach a stricture situated high up towards the entrance of the canaliculi. At one time metal tubes were placed in the cavity of the sac, which were intended to be healed in, and permanently to occupy its cavity; but Nature, disliking foreign bodies, even when introduced by a surgeon, always rebelled against them, and did her best to dislodge them, either upwards or downwards. The *style* maintained its ground longest, and until recently formed the *ultima ratio* in every case of obstinate lacrymal obstruction. It was made long enough to reach from just below the tendon of the orbicularis palpebrarum, where an incision was made into the cavity of the sac to admit it, to near the floor of the nostril. The upper end was furnished with a nail-like head, to support the style in its proper position; and it was intended that the tears, entering by the puncta and canaliculi, should come into contact with the piece of metal, and glide down by the side of it into the nose. The style was to be taken out every day, cleansed and replaced; and at first the cure appeared perfect; but patients, from timidity, awkwardness, or carelessness, neglected this precaution, the instrument was seldom, in some cases never, removed, and eventually it became encrusted with earthy deposit from the tears, or was consumed by oxydation; the skin around the nail-shaped head was drawn in, and at the same time blackened with the sulphuret of silver,—in short, the style, so highly praised at first, became at last a source of annoyance and disappointment.

About eighteen years ago, Bowman* suggested a very simple and useful operation, which, in many instances, suffices to cure *epiphora* resulting from contraction or displacement of the puncta, while at the same time it affords a ready access to any obstruction that may exist in the course of the sac or lacrymo-nasal canal.

Suppose that, in consequence of chronic ophthalmia, or from any other cause, the lower punctum has become displaced, so that, instead of facing towards the eyeball, it is directed upwards and forwards; the tears in such a case will run over the edge of the lid; and the object of the surgeon must be to transfer, as it were, the displaced punctum to a position where it can catch the tears before they overflow the border of the tarsus. The lid being put upon the stretch, a fine grooved director, or, in default of that, an ordinary punctum-probe, is to be passed along the whole course of the canaliculus, and held firmly there, while a fine sharp-pointed knife is run along the probe, as far as the caruncle, so as completely to lay open the canal, and thus extend its orifice backwards to the point where the tears accumulate. A very handy little knife, with a slightly bulbous point, has been invented, with which the canaliculus can be slit up without the use of any probe or director.

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* *Medico-Chirurgical Transactions* for 1851, p. 338.

For several days after the incision has been made through the upper wall of the canaliculus a probe must be passed along its track, to prevent the lips of the wound growing together. In some persons it may be necessary to use the probe for ten days or more; in other cases there is hardly any disposition in the edges of the wound to unite.

When the overflow of tears depends simply on faulty position of the punctum, this laying open of the canaliculus may of itself effect a cure. In cases of obstruction in the lacrymal sac or its nasal duct, the incision affords an easy access to the seat of stricture.

Occasionally, however, another complication exists in a narrowing of the canaliculus just at its point of communication with the sac, which may prevent the passage of a probe sufficiently large to act upon the stricture. In such a case a small straight cannula, containing a lancet-shaped point, which may be protruded or withdrawn by means of a spring,—in fact, Stafford's instrument for dividing urethral stricture, made on a miniature scale,—must be carried along the canaliculus, and employed upon the constricted spot.

The probes for dilating strictures in the sac or its canal must be of various degrees of thickness, but all sufficiently strong to sustain the requisite amount of pressure without bending. They are best introduced by the surgeon standing behind the patient; and it will be found advisable to avoid using those of too small a size, as they are of course more likely than those of a larger size to catch in a fold of membrane, or even to pierce the membrane covering the bony walls of the canal.

The tarsus being put on the stretch, the probe is passed along the newly-opened canaliculus until its extremity strikes against the inner wall of the sac. Still keeping its extremity in contact with this part, the probe is raised to a vertical position, and then carefully carried downwards to the seat of stricture. The canal inclines somewhat backwards, and this inclination is to be carefully borne in mind. The surgeon must feel his way with the point of the instrument, and be on his guard against using unnecessary force. In cases of old dilatation of the sac, its relaxed lining membrane readily catches in a fold against the point of the probe, and the surgeon must learn to discriminate between a check arising from this cause, and the obstacle encountered by the instrument becoming impacted in the constricted lacrymo-nasal canal. The length of the instrument which has been passed in, and the patient's own feelings, will prove whether the point of the probe has entered the nasal cavity.

It sometimes happens that, immediately after the first passage of the probe, the surgeon is able, by pressure over the sac, to force all its contents down into the nose; but if there has been much difficulty in passing the instrument, the membrane becomes swollen, and will allow the contents of the sac to pass only after the swelling has been relieved by fomentation.

No fixed rules can be laid down as to the frequency with which the probe is to be used, nor as to the length of time required for a cure. This will vary from a few weeks to several months, and relapses frequently occur long after the stricture appears to have been completely overcome. Too frequent use of the probe will set up irritation, and induce a more abundant muco-purulent secretion. When this takes place, the probe must be laid aside for a week or two, and fomentation, with water-dressing at night, be substituted.

During the whole course of treatment by means of the probes, the patient must never neglect several times a day to press out the contents of the sac, endeavouring to do this in a downward direction; or, if this cannot be effected, by pressure through the puncta.

Those who are about to treat a case of long-standing lacrymal obstruction by the passage of probes, should clearly understand how much care, tact, and patience such an undertaking requires. In consequence of the minuteness and delicacy of the parts concerned, the treatment of a stricture in the lacrymo-nasal duct demands even greater care and skill than that of a stricture in the urethra; and I am sure that those who have seen much practice will bear me out in asserting, that by far the greater part of obstinate and dangerous cases of the latter kind are due to meddlesome surgery rather than to any original disease.

The surgeon must bear in mind that the walls of the lacrymal sac and duct are composed of extremely brittle and fragile bones, and the rough introduction of a probe may either break some of these, or tear away the delicate and vascular membrane which covers them. Besides, as the lacrymo-nasal canal is a bony tube, all thickening of its lining membrane must take place concentrically; and therefore any undue violence, by setting up inflammation, is sure to increase instead of lessening the cause of stricture.

Even when all possible care and skill have been employed, the treatment of stricture in the lacrymal passages, by the means just described, is often extremely tedious; for the affection may be complicated with great dilatation of the sac, caries of the adjacent bones, or false passages of various kinds, resulting from previous mismanagement.

Dacryolithes.—This term has been applied to certain concretions which are sometimes met with in the lacrymal passages, in the canaliculi, or in the sac, caused by the earthy salts contained in the tears becoming deposited in the form of a calculus. Watering of the eye, repeated attacks of inflammation in the sac, or swelling and suppuration about the canaliculus, and pain when the part is pressed upon, are the more obvious symptoms. A probe carefully passed into the canaliculus, or through it into the sac, would detect the presence of the concretion, which must be cut upon, and extracted with a scoop or other instrument.

Irritation of the lacrymal passages is sometimes caused by the intrusion of a detached eyelash into one of the canaliculi. In this curious accident the hair enters at the punctum, and passes on as far as the abrupt bend which the canal makes at about a line's distance from the orifice. Here it is arrested; its point protruding to a greater or less extent, and irritating the caruncle and semilunar fold. The symptoms induced are a pricking and itching about the inner canthus, with reddening of the neighbouring conjunctiva. If the hair be short, its point will protrude so little as to make it very difficult of detection; on its withdrawal, all irritation at once ceases.

DISEASES OF THE LACRYMAL GLAND AND ITS DUCTS.

The works of foreign writers present a formidable array of diseases affecting this gland, almost every form of acute and chronic inflammation, and enlargements, both simple and malignant, being recorded; while our own countrymen appear to have met with but few cases of the kind. My own experience would lead me to believe that compared with the other glandular structures of the body, the lacrymal gland is very rarely the seat of disease. Its sheltered position beneath the projection of the frontal bone guards it, to a great extent, from external violence, and it appears but seldom to participate in the inflammation of neighbouring tissues.

One rare affection consists in an accumulation of tears in one or more of the obstructed excretory ducts, whereby a cyst-like tumour is formed in the upper lid (*dacryops*), becoming very visible when the lid is everted. If one of these enlargements is punctured, without attention being paid to the after-treatment of the case, the opening is apt to become fistulous (*dacryops fistulosus*), the lacrymal secretion continuing to distil through a minute aperture in the skin. Such a case may be treated on the same principle as a fistula of the parotid gland, namely, by passing in at the opening a thread, which, having been carried through the thickness of the lid, and brought out at its conjunctival surface, has a small knot made at one end. This knot is then drawn into the fistula, and, by continued traction of the other end, is made to ulcerate its way through the conjunctival surface. The tears being thus diverted, the fistulous orifice in the skin may be closed by paring and uniting its edges.*

Should the lacrymal gland really become the seat of malignant deposit, or should it be deemed advisable to extirpate it on account of chronic enlargement, or for any other cause, the operation would be a simple one, and would offer nothing worthy of remark.

In the only instances, three in number, where I have myself extirpated the gland, it was not the seat of disease, but was removed to do away with the inconvenience of the overflow of tears, the puncta and canaliculi having been wholly destroyed by extensive burns. In one of these cases an artificial pupil I had made would have been rendered almost useless, in consequence of the flooding of the eye with tears, had their secretion been allowed to continue.†

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* See a well-reported case of *dacryops*, by Hulke, *Ophthalmic Hospital Reports*, vol. i. p. 287, 1859. In this instance a loop of thread was made to include a certain portion of the conjunctiva.

† See *Guide to the Practical Study of Diseases of the Eye*, 2nd edition, 1859, p. 417.

CHAPTER XII.

DISEASES OF THE EYELIDS.

So many various tissues enter into the formation of the eyelids that they must necessarily be liable to a great variety of diseases; but it would be absurd to attempt a description of all the morbid conditions which they share with the other portions of the common integument of the body.

The *orbicularis palpebrarum* is subject to a spasmodic twitching of some of its fibres, usually those of the lower lid, producing a visible quivering of the skin, popularly termed the 'live-blood.' To persons of an irritable nervous system this becomes teasing from its frequent recurrence. It is commonly the result of intestinal irritation, especially that produced by ascarides; and a few doses of purgative medicine, followed up by tonics, usually suffice to put an end to the annoyance.

Epicanthus is a term applied to a slight deformity, sometimes observed in children, consisting in a crescentic fold of redundant skin at the inner corner of each eye, partly or wholly concealing the caruncle. It is associated with a depressed form of the nasal bones, and if, in after life, the bridge of the nose becomes more prominent, the fold of skin, to a certain extent, diminishes, although it never wholly disappears. *Epicanthus* imparts to the face an unpleasant, Chinese expression; and the only cure is by pinching up and removing a vertical fold of skin on the median plane, just between the eyebrows, and then bringing the wound accurately together.

Ptosis, or drooping of the upper lid, may exist in various degrees, producing merely a slight deformity, or becoming complete, so as wholly to obstruct vision. It will be spoken of under 'paralysis of the third nerve.' In some cases of congenital drooping of the lids it is possible that the levator palpebræ muscle may be altogether wanting. Patients with this defect have no power of moving the lids except by calling into action the occipito-frontalis muscle. The lids do not present that transverse fold in the skin, which, in the normal state, corresponds to the upper part of the eyeball, but are smooth and unwrinkled from the eyebrow to the tarsus, while the forehead is furrowed by the frequent action of the occipito-frontalis.

The terms *Entropion* and *Ectropion* are respectively applied to the inversion and eversion of the margins of the lids.

The simplest form of *entropion* is that which is occasionally met with in children, the subjects of irritable ophthalmia, as a result of spasm of the orbicularis palpebrarum. Extreme intolerance of light induces this muscle to contract so often and so forcibly that at last the lower tarsus rolls over against the globe, causing an inversion of the eyelashes, which greatly adds to the patient's distress. Contractile collodion, painted on the skin of the lower lid, draws the part into a proper position, and keeps it so while suitable remedies are being employed to subdue the original disease.

A similar spasmodic inversion of the lower lid happens to old persons, in whom the skin is relaxed and the tarsus flaccid. The muscular contraction is repeated until at last the lid becomes so rolled upon itself, that both the cilia and the tarsus are completely hidden, and the border of the lid appears to be formed of common integument. In these cases of extreme inversion the irritation is really much less than when the inversion exists to a slight degree. For in the latter case the points of the cilia are brought into direct contact with the ocular conjunctiva, while in the former case the tarsus rolls over so completely, that the points of the cilia become buried in the fold of palpebral conjunctiva, and consequently do not come into contact with the globe at all.

A far more severe and obstinate kind of entropion is that which follows chronic inflammation of the palpebral conjunctiva, especially neglected or maltreated purulent ophthalmia. The upper tarsal cartilage becomes so much curved upon itself, that the whole range of eyelashes turns backwards against the globe. This curving of the tarsus is often aggravated by the long-continued application of solid nitrate of silver and sulphate of copper to a granular conjunctiva. If in such cases we evert the lid, we find a pale smooth cicatrix occupying its deep concavity. Partial or complete inversion of the margin of the lids may also result from contraction of the conjunctiva, following injury from acids, caustic alkalies, or burns.

A great variety of operations has been devised for the cure of entropion. In that form, so common in old persons, where the inversion is owing to contraction of the orbicularis muscle acting upon a flaccid lid, a cure can usually be effected by removing an elliptical portion of the skin of the lid, together with the subjacent fasciculus of muscle, and then accurately uniting the wound with fine sutures. It requires care exactly to calculate what quantity of skin should be taken away; and of course the removal of too large a portion would cause eversion of the lid, and so produce a deformity of the opposite kind.

If the tarsal cartilage be so much curved that removal of skin is insufficient to draw the eyelashes away from the globe, recourse may be had to an expedient suggested by Streatfeild. The skin of the lid being carefully dissected up, sufficiently to expose the convex surface of the tarsal cartilage, a long narrow wedge-shaped slice is cut out from this, so as to form a groove extending the whole length of the tarsus. The curved cartilage thus becomes bent backwards, as it were, and the skin being restored to its position, is united along the cut edges with a few fine sutures.

Should all these plans fail, and the eyelashes still irritate the globe, the whole row must be dissected off, together with that portion of the tarsal margin in which their roots are imbedded.

Ectropion, or eversion of the lids, may exist in the most various degrees. Its worst form is seen as a result of burns of the face, followed by extensive contraction of the cicatrices.

A spasmodic form of ectropion is often seen in purulent ophthalmia of infants, and in scrofulous and irritable ophthalmia of older children. In infants the unsightly appearance of the bright red and swollen conjunctiva gives rise to great alarm in those who have the care of the child; but they may be assured that as the inflammation subsides, the deformity will gradually cease.

The chronic forms of *ectropion* in adults, which are produced by granular thickening of the conjunctiva after purulent ophthalmia, or by the contraction of cicatrices in the skin surrounding the palpebral aperture, the result of ulcers, burns, exfoliation of bone, &c., require a variety of operations, according to the special nature of the case.

When, after chronic ophthalmia, the everted conjunctiva of the lower lid presents a thick mass of granular excrescences, without any material elongation of the tarsus, or disease of the neighbouring skin, a cure may sometimes be effected by removing with scissors the greater portion of the palpebral conjunctiva, and then uniting the edges of the wound with very fine sutures. These may be left to ulcerate out by themselves, the lid being kept in proper position by the aid of a pad of lint laid along the margin of the tarsus, and fixed by means of several layers of lint saturated with collodion. In this way the lids are kept in contact with each other, and the apparatus need not be disturbed for several days. When the wound in the palpebral conjunctiva is closed, the loose stitches may be removed, and the pad of lint replaced until the cure is complete.

In very old and severe cases of ectropion, the tarsus becomes so much stretched, that, in addition to the removal of conjunctiva, it is necessary to take away a wedge-shaped portion of the elongated lid itself. Still worse cases, such as those resulting from burns or disease of bone, may require the formation of a new eyelid by the transplantation of a portion of adjacent healthy skin.

Trichiasis consists in an irregular growth of the eyelashes, the general form of the tarsus itself not being changed. Tinea ciliaris very commonly causes trichiasis, by inducing cicatrisation about the roots of the cilia. Sometimes three or four fine eyelashes present their points towards the globe, or even a single hair will grow in this direction, all the other hairs maintaining their natural position.

Trichiasis, when existing only to a slight extent, causes constant annoyance to the patient, by a sense of pricking, and by the constantly irritable and watery state of the eye which it induces. If only a few hairs grow irregularly, the removal of the entire tarsal margin need not be resorted to. The offending hairs must be carefully plucked out from time to time; or if they form a little group, they may be removed by dissecting out the small portion of lid external to the tarsus itself, in which their roots are implanted, and then uniting the wound with a suture.

To draw out an eyelash by the root seems a very simple and trifling matter; and yet there are few surgical manipulations in which care and the skilful use of a well-made instrument are so necessary. The cilia-forceps one commonly meets with are liable to cut the hair instead of merely grasping it firmly; and the stiff broken stump of a hair causes far more distress to the patient than its natural fine point. The hair should never be sharply jerked out, but removed with a slow steady pull.

INFLAMMATION OF THE LIDS.

The eyelids are of course liable to the various forms of inflammation which attack similar tissues in other parts of the body.

A few inflammatory affections of the lids seem to demand notice on account of their presenting peculiarities of appearance, or being distinguished by special names.

A *stye* (*hordeolum*) is in fact a minute boil. It begins at the very edge of the lid, as a small, red, tense swelling, and at first is merely troublesome by the itching and sense of stiffness it occasions. As the inflammation goes on, the redness and swelling may more or less involve the whole lid, so that the eye becomes completely closed. In a few days matter forms, and shows itself at the summit of the stye ; the cuticle gives way, pus and a small slough of areolar tissue escape ; and then the redness and swelling subside, and the lid soon assumes its former appearance.

Scrofulous and delicate children are the usual subjects of styes, and they are comparatively rare in adults. Attention to the state of the bowels, carefully regulated diet, and the use of tonics, comprise the general treatment. Locally, warm water-dressings are greatly to be prefered to poultices, which are apt to irritate the skin. The stye should never be rubbed or squeezed ; and no incision is necessary, except perhaps, a slight puncture through the cuticle when the pus is pointing.

Abscess sometimes occurs in the Meibomian follicles. These organs pour out upon the edges of the lids a greasy secretion, which prevents the tears running over, and causes them to flow onwards to the puncta. Sometimes a follicle becomes obstructed at the orifice, and the retained secretion forms a minute solid granule, looking, when extracted, like a little grain of sand. If it projects sufficiently to touch the globe, a slight irritation is produced until the granule is removed.

If, however, the solidified secretion cannot in this way escape through the orifice of the follicle, it causes irritation, and at last a small abscess in the follicle itself. The lower lid is commonly the seat of these abscesses. They commence with a small patch of vascularity in the palpebral conjunctiva, a short distance from the free border of the tarsus, and gradually a yellow dot of pus forms in the centre of the vascular patch. If the conjunctiva at this point be punctured with a lancet, and a small scoop be introduced, the cause of the suppuration, a little nodule of stearine, about the size of a poppy-seed, may usually be turned out, and then all irritation subsides.

Tinea ciliaris,—termed also *ophthalmia tarsi, psorophthalmia, tinea palpebrarum,* &c.,—is one of the most common and troublesome diseases of the lids. It is too often neglected during the early stage, when alone it is really curable, and the surgeon is probably consulted for the first time when many of the hair-bulbs have already been irreparably destroyed, and the remaining hairs are misplaced and inverted, constituting the state called *trichiasis.* This term is frequently employed as if synonymous with entropion, but it ought properly to be restricted to mean displacement of the *hairs* themselves, while entropion signifies a turning-in of the *lid.*

Tinea ciliaris is seldom seen in its early pustular form; for the little pustules at the roots of the eyelashes soon break, and the discharge exuded from them dries into crusts, which cling about the hairs, matting them together, and sometimes almost concealing them from view. Tinea ciliaris, if allowed to go on unchecked, gradually destroys the tissues which secrete the hairs; and when the disease has thus exhausted itself, and the last crusts have fallen off, the tarsi, instead of presenting sharply-beveled edges, appear rounded off, the skin and conjunctiva being gradually blended together into one smooth, red, shining cicatrix, in which neither cilia nor Meibomian orifices can be traced. Very often the puncta also become obliterated, and the tears consequently run over the cheeks, causing irritability and blinking of the lids. This is the condition to which the term *lippitudo* should be restricted; *tinea ciliaris* being understood to mean that state in which active disease at the root of the eyelashes is still going on.

In the *treatment* of tinea ciliaris, the chief difficulty arises from the age of the patients. Daily attention is required, to prevent the accumulation of crusts, which should be carefully washed off night and morning. Patients often derive but little benefit from the remedies prescribed, in consequence of this regular cleansing being neglected. It is useless to apply ointments any where except upon the very surface of the minute sores at the roots of the hairs; and if the latter are kept closely cut with scissors, the application of ointments, and the prevention of crusts, are greatly facilitated. Of course, this cutting of the eyelashes requires to be done by the surgeon himself, and the ointment should be neatly applied with a pencil. When cases cannot be thoroughly looked after, it is perhaps better to prescribe lotions, as they can hardly fail to reach the seat of disease. Ung. hydr. nitratis, ung. hydr. nitrico-oxydi, and ung. zinci oxydi, sufficiently diluted with ung. cetacei, or fresh lard, are the best ointments. The acetate of lead may be used as a lotion, in the proportion of from two to four grains in the ounce of distilled water.

The worst forms of lippitudo may often be greatly relieved by slitting up the canaliculi in the manner described at page 227. By this means the overflow of tears is checked, and this of itself is an immense comfort to the patient; while, at the same time the tendency to ectropion, which long-continued lippitudo often induces, is considerably diminished.

Phtheiriasis.—Among the irritable conditions of the eyelids, I may here notice that arising from the presence of lice. These creatures are 'crab-lice' (*phthirius*), a species quite distinct from that which infests the scalp (*pediculus*). They thrust their heads into the skin at the roots of the cilia, and by means of the sharp claws with which all their legs, except the first pair, are provided, hold on so firmly, that they cannot be dislodged without great difficulty.

Phtheiriasis of the eyelids is an extremely rare affection, at least in this country, and I have met with only three or four instances, all of which occurred in children. On superficial examination, the cases are very similar to those of tinea ciliaris. The eyelashes present a powdery appearance, and their roots seem to be clogged with yellowish-gray and brown crusts; but by careful scrutiny of these supposed crusts, the movements of the insects may be detected; and the powdery appearance of the cilia is owing to their being clogged with the exuviæ of the creatures, and dried sanies from the wounds they have inflicted. The insects may speedily be destroyed by thoroughly smearing into the roots of the eyelashes the white precipitate ointment (ung. hydrarg. ammonio-chloridi).

MORBID GROWTHS OF THE LIDS.

The following are the more common swellings which appear in or upon the lids.

Cysts, of two distinct kinds. Those of the first kind, extremely common, are met with both in the upper and the lower lid (*Encysted tarsal tumour*, Tyrrell; *Chalazion*, Mackenzie); the others are found almost invariably at one spot, namely, just over the external angular process of the frontal bone, to the periosteum of which they are attached.

Molluscum is met with on the lids of children, and seems identical with the little masses termed by Tyrrell 'glandiform,' and by Mackenzie 'albuminous' tumours.

Warts are sometimes found on the lids, differing in no respect from those on other parts of the body.

Nævi materni, resembling those of other parts.

1. *Cysts* of the lids are met with at all ages. They may exist singly, or several may appear together, coming successively to their full growth. The skin over them is quite unchanged, so that, when small, they are hardly recognisable except by the touch. They feel like half a hemp-seed or half a pea fixed by the flat side to the tarsal cartilage, and presenting a convexity towards the skin, which may be freely moved over them. They rarely exceed the size of a pea, except when suppuration has taken place within them.

If the lid be everted, the position of the cyst is recognised by a thinning of the tarsal cartilage, forming a dusky spot, around which the conjunctiva is reddened. These cysts may remain of a moderate size during life, without causing any inconvenience; but sometimes they suddenly inflame and become enlarged, the skin over them reddens and at last gives way, a small quantity of pus escapes, and afterwards a thin sanies continues to ooze from the aperture. But more commonly the pus makes its way through the palpebral conjunctiva, and then a little red fungous mass gradually protrudes, which, by the continual pressure of the eyeball, becomes flattened out into a mushroom shape.

When these cysts are so small as to escape ordinary observation, they require no treatment; but if they become so large as to be unsightly, and, still more, if they inflame and suppurate, they must be treated in the following way. The lid being everted, a crucial wound is made through the conjunctiva into the cavity of the cyst. If the inflammation has been acute, pus escapes, otherwise a little serum. A scooped probe passed into the cavity, and twirled about in various directions, brings out the accumulated epithelium, which has a jelly-like appearance. Blood then fills the cyst, and makes it as large as it was before the incision. The patient, however, may be assured that this swelling will gradually subside. To prevent premature closing of the wound, and refilling of the cyst, the probe should be used in the way just described every third day for about a fortnight. The walls of the cyst come together, and ultimately form a slight thickening in the lid, just perceptible by the finger applied to the skin.

Fibrous cysts, varying in size from that of a large pea to that of a hazel nut, and containing sebaceous matter and hairs, are almost invariably confined to one situation, namely, just over the external angular process of the frontal bone. They appear to be congenital; at least, I have seen them of considerable size in infants four or five months old. The skin over the cyst retains its natural appearance, and it is only on account of the unsightliness that the surgeon is consulted.

In dissecting out the cyst, which is the only mode of treatment, great care is requisite to avoid cutting into it: and especially while the cyst is being separated from the periosteum to which it always adheres pretty closely. The cavity is lined by a smooth membrane, and is filled with white greasy material interspersed with loose hairs. In a cyst removed by one of my colleagues from an infant five months old, these hairs were still growing from the lining membrane. It seems that, in the course of years, these hairs may attain a considerable size, while the fatty material degenerates into oil. Such was the case in a very large cyst which I removed from a woman between thirty and forty. The skin had become so much thinned as to have assumed a dusky hue; and in endeavouring to dissect out the cyst I punctured it, and there escaped a quantity of perfectly clear yellow oil. There remained within the cavity only some detached black hairs, loosely curled together, and as strong as those of the head.

2. The little masses described by Tyrrell as 'glandiform tumours' appear to be identical with *molluscum*, which attacks children in the form of small, white, rounded bodies, scattered over the lids, the alæ nasi, and about the corners of the mouth. When very small, these bodies are slightly reddish; but when as large as a pea, they are white, and exhibit at the apex a minute opening through which a milky fluid exudes on pressure. The readiest way to get rid of these unsightly masses is to split them all through with a lancet, and then to nip out with the nails the contents of each. The mass, when pressed out, looks almost like a fragment of parotid gland.

3. *Warts* may be snipped off with scissors, the little wound

being touched with nitrate of silver; or they may be tied at the base with a fine silk, and allowed to slough.

4. *Nævi* of the lids differ in no respect from those met with in other parts of the body; but they require more careful and discriminating treatment, on account of the importance of avoiding as much as possible, any considerable loss of skin; a large cicatrix being not only in itself unsightly, but likely, by its contraction, to cause distortion of the lid. Subcutaneous ligature, therefore, or the introduction of probes coated with fused nitrate of silver, must be preferred to including any portions of skin within a ligature, or extensively destroying it with escharotics.

I have seen injections of alum cause sloughing of the lids and great subsequent deformity; and such a result might follow the injection of any similar fluid into the loose areolar tissue of the part, unless some contrivance can be used to restrain the fluid within proper limits.

In the following case an injection of tannin proved successful.

A young lady was brought to me with a nævus on the upper lid, the size of a small hazel-nut. I was informed it had already been twice operated on by the introduction of threads steeped in nitric acid, and much inflammation and sloughing had ensued, as was proved by a considerable cicatrix of the skin near the outer canthus. The apex of the swelling was on the free margin of the lid, on everting which, a small bunch of veins, about the size of a barley-corn, was seen projecting through the tarsal cartilage, only covered by conjunctiva. The nævus seemed to be formed almost wholly by veins, the larger trunks of which could be felt through the skin, as they emerged below the superciliary ridge.

Having enclosed the whole upper lid in a 'ring forceps,' I could completely isolate the nævus from its parent veins, and I then punctured it with a very small narrow knife (Hays's needle-knife), and cut up its tissue subcutaneously. Being emptied of its blood, the nævus collapsed; and I next, with a fine syringe, threw in a few drops of a saturated solution of tannic acid. After a short pause, I relaxed the pressure of the ring forceps, and so allowed the returning blood to mingle with the injected fluid.

The subsequent inflammation produced a good deal of swelling and hardness of the lid; but the only slough was a mass about the size of a small pea, which made its way out at the little wound. The final result was complete obliteration of the nævus.

Carcinoma rarely commences in the lids, although it may spread to them from other parts. Should it be already far advanced when first brought under the surgeon's notice, extirpation would hardly be attempted. Small, hard, suspicious growths at the margin of the tarsus may be removed by excising a wedge-shaped portion of the lid on which they grow, and then uniting the wound with sutures.

Epithelial cancer chiefly attacks the skin over the lacrymal sac, and from that point extends over the nasal and superior maxillary bones, having the appearance of a shallow pale ulcer, with an irregular outline and uneven borders, and with a scarcely perceptible quantity of secretion. Chloride of zinc, made into a paste, and applied over the entire surface of the sore, so as to include its edges, will sometimes very effectually destroy the morbid growth, and it may be reapplied whenever any part of the border of the sore begins to exhibit fresh activity. Of course, the strictest attention to general health would be combined with the local treatment.

INJURIES OF THE LIDS.

Ecchymosis.—An effusion of blood into the areolar tissue of the lids, popularly termed 'a black eye,' is commonly the result of a blow; but it may arise from other causes, as, for instance, from the unskilful employment of leeches. The sufferer is always most anxious to get rid of the ecchymosis as quickly as possible; and I know of no treatment so efficacious as that handed down by the traditions of pugilism, consisting in the application of a poultice formed of the freshly-scraped root of the 'black bryony' (*tamus communis*), mixed with a due proportion of linseed-meal or bread-crumbs. Poultices of this kind produce a stinging sensation in the skin, and, if regularly applied for a day or two, seldom fail in effecting a complete absorption of the effused blood.

Emphysema.—This, like ecchymosis, is usually the result of a blow with the fist, which fractures some of the thin brittle bones, such as the lacrymal or ethmoid, forming the inner wall of the orbit. If, shortly after such any injury, the patient blows his nose, the eyelids suddenly puff up, so that he is unable to separate them. On pressing the part with the fingers, we at once perceive the peculiar crackling caused by the presence of air in areolar tissue. If the patient abstain from blowing his nose, the effused air soon becomes dispersed, and the swelling disappears.

Wounds of the lids have already been considered.* They are to be treated on the common principles of surgery which apply to other regions. The careful surgeon would naturally be alive to the importance of obtaining the nicest adaptation of cut surfaces in parts so open to observation. The yielding nature of the skin of the lids, and its plentiful supply of blood, offer peculiar facilities for effecting close and smooth union of wounds by means of fine sutures, in applying which the greatest care must be taken to avoid any irregularity and puckering of the cut edges.

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* See INJURIES OF THE FACE.

CHAPTER XIII.

DISEASES OF STRUCTURES WITHIN THE ORBIT.

Structures very dissimilar, as regards their nature and functions, are grouped together in the present chapter; but they are all more or less concerned in supporting or imparting motion to the eyeball. The various morbid growths within the orbit, which cause displacement or impair the mobility of the organ, are also here briefly noticed.

PROTRUSION OF THE EYEBALL.

(*Proptosis oculi; Ophthalmo-ptosis; Exophthalmos.*)

Various causes may induce an unnatural prominence of the eyeball; but cases are sometimes met with in which this prominence seems of itself to form the whole morbid condition. The eyes have a remarkably staring expression, and look as if they were much too large for their sockets. The tarsi can be brought into contact; the eyes themselves move freely in all directions, and sight is unaffected. The equal amount of prominence in both eyes, and their unimpaired functions, at once remove any suspicion of orbital tumour.

Women of feeble and hysterical constitution, and those affected with bronchocele, are the usual subjects of this deformity, the cause of which is very obscure. Atony of the recti muscles has been suggested; and no doubt a weakened state of these muscles might produce a certain amount of prominence of the eye, but would be incompatible with its free motion. I have never seen any cure or benefit result from treatment in these cases of proptosis.

Dislocation of the eyeball from the socket is an accident we often hear of, but I need hardly say, that without rupture of the optic nerve the eye cannot be thrust upon the cheek, where it so often figures in the exaggerated accounts of patients. What really takes place is, probably, the lodgment of the upper lid behind the greatest convexity of the globe. I have seen this accident occur, when a surgeon, anxious to explore the upper surface of the sclerotic, in search of a foreign body, or for some other cause, has too forcibly thrust back the upper lid. The tarsus, being forced beyond the summit of the eyeball, has suddenly slipped backwards, and become fast locked behind it. A wire elevator or a bent probe will enable the surgeon to lift up the tarsus and restore it to its place.

Hydatids, cancerous growths, and exostoses, by encroaching upon the cavity of the orbit, all give rise to gradual displacement of the eyeball. As this displacement increases, the movements of the eyeball become more and more limited, until at last it remains quite fixed.

It requires much careful investigation into the history of the case to enable the surgeon to determine the nature of the morbid growth. Exostoses are the slowest, and encephaloid tumours the most rapid in their progress. It is sometimes possible to pass in the tip of the little finger between the globe and the anterior edge of the orbit, and thus partially to explore the surface of the tumour. Hydatid cysts are recognised by a feeling of elasticity and fluctuation; and in doubtful cases a puncture with a fine trocar will sometimes reveal the true nature of the mass.

The removal of morbid growths from the orbit requires the utmost care, to avoid inflicting injury upon the eye itself or the optic nerve; and, before attempting such an operation, the surgeon should be well convinced that the mass is limited to the orbit, and has not extended into it from the cavity of the skull.

Abscess in the orbit occurs as a result of injury, such as the entrance of a foreign body; or it sometimes seems to be the effect of a chill. In a less acute form we meet with it as a sequela of fever and erysipelas. The suppuration is ushered in with rigors and depression; the conjunctiva and areolar tissue of the globe are red and infiltrated, the lids swollen and livid; the eyeball becomes prominent and immovable; and at length fluctuation can be detected by the finger passed in between the lids and the globe. The rapidity with which these symptoms follow each other would serve to distinguish suppuration from the growth of a tumour. Until fluctuation occurs, the existence of pus in the areolar tissue of the orbit is very obscure; and the deep exploratory punctures which some surgical writers advise to be made between the eyelids and the globe must be very unsafe, considering how closely the eyeball is surrounded with muscles and nerves, which random incisions would endanger. A careful surgeon may sometimes succeed in safely opening a deep orbital abscess; but I have known a total division of the optic nerve to result from an over bold incision.

Chronic abscess in the orbit is commonly the result of caries or necrosis; and the denuded bone will be felt by introducing a probe through the opening by which the pus has been evacuated.

Orbital abscess, even of the acute and so-called phlegmonous kind, so commonly occurs in depressed and feeble subjects, that light and nutritious diet, with a due proportion of stimulants, will be indicated instead of abstinence and leeches. The bowels should be rapidly unloaded, and then narcotics given in doses just sufficient to soothe pain and induce sleep. Bark and ammonia, wine and other tonics, will often be needed in increased quantities during the free suppuration, which not uncommonly follows the opening of the abscess. Warm water-dressing will be throughout the best local application.

AFFECTIONS OF ORBITAL NERVES.

The eyeball and its appendages derive their sensibility from branches of the ophthalmic division of the *fifth* nerve, which not only endows these parts with feeling, but also so far influences their blood-supply that total anæsthesia of the nerve is followed, sooner or later, by deranged nutrition of the cornea, and by other phenomena generally described as 'inflammatory.'

These phenomena have been already noticed in the Chapter treating of Diseases of the Cornea; and at present we may confine our attention to those motory nerves which supply the muscles of the lids and globe,—namely, the third, fourth, sixth, and 'portio dura' of the seventh, or facial.

The orbicularis palpebrarum is supplied by the last-named nerve, and when this is paralysed, the tarsi can no longer be brought into contact. If the patient is told to shut the eye, the lids remain immovable, if the paralysis is complete; or if it be only partial, a slight attempt at closure takes place. At the same time the eyeball is rolled upwards by the action of the superior rectus, as if seeking in that way the shelter of the upper lid. Sometimes the branch supplying the orbicularis palpebrarum is alone paralysed, but more frequently this is affected in common with the other facial muscles.

The orbital nerves, it will be remembered, are distributed as follows: the third to the levator palpebræ, the superior, inferior, and internal recti, and inferior oblique muscles; and also to the iris, through the medium of the ophthalmic ganglion. The fourth nerve supplies the superior oblique, and the sixth the external rectus.

It is not necessary that all the muscles supplied by one of these nerves should be affected at the same time, or to the same extent; but for the sake of illustration we will assume cases in which the various nerves have wholly lost their motory function.

The following are the symptoms of paralysis of the *third* nerve. The upper lid hangs motionless, and is in contact with the lower one (*ptosis*). On lifting it we find the globe abducted, so that the cornea is turned towards the temple. The patient can direct the eye still farther outwards, but neither inwards, upwards, nor downwards. The pupil is dilated and fixed, and on that account vision, especially for near objects, is somewhat impaired, although the optic nerve and retina may be wholly unaffected. By looking through a small aperture vision becomes perfect. If the patient looks with both eyes at objects placed on that side of him towards which the affected eye is abducted, they appear single; while objects in the other direction appear double. If all the branches of the third nerve are paralysed, the inferior oblique muscle of course ceases to act, and the superior oblique having no antagonist, rotates the globe on its antero-posterior axis, and hence vertical objects seen with the affected eye appear oblique.

If the *sixth* nerve alone be paralysed, the eye is turned inwards. This inversion can be increased at will, and the eye can be freely moved upwards and downwards; the pupil is of natural size and active, and the upper lid retains its motions unimpaired. If the patient looks at objects on that side towards which the eye is inverted, they appear single; but objects in the other direction are double.

Paralysis of the *fourth* nerve is much less common than either of the two forms already mentioned, and, on account of the very slight change it causes in the position of the eye, is very difficult of detection. The paralysis is chiefly to be recognised by its subjective phenomena. If, for instance, the patient with both eyes open fixes his attention on some straight line on the ground, as the edge of a gravel-walk, or the curb-stone of a foot-pavement, he sees two lines, one in its real position, and the other forming with it a more or less acute angle. If with both eyes he looks at a near object, such as a large capital letter, at such an angle that it appears double, the image perceived by the affected eye will incline from the perpendicular, and its lines cannot be brought parallel to those seen by the sound eye, unless the patient inclines his head to one side. The letter T or a +, as containing right angles, are good forms for testing the defect.*

The *treatment* of paralytic affections of the orbital nerves must be based on a careful investigation into the symptoms of each individual case, for the causes of paralysis may be very various. Slow, and eventually total, paralysis of one or all the nerves which enter the orbit may depend upon chronic changes in the brain itself, or the dura mater, the growth of tumours, disease of bone, &c. Sudden paralysis may follow apoplectic effusion or other injury to the cerebral structure, or may depend upon rheumatic inflammation of the fibrous tissues immediately surrounding and investing the nervous trunks.

Of course the prognosis would vary greatly accordingly as one or another of these causes had induced the paralysis. In the case of chronic brain-disease, or the growth of intracranial tumours, the treatment could be only palliative. The probability of recovery in cases of apoplexy would depend upon the extent of the extravasation.

If one or more of the orbital nerves were suddenly paralysed, and at the same time other parts of the body were affected with loss of motory power, while the brain itself gave evidences of its whole circulation being disturbed,—there would be comparatively little chance of the orbital muscles recovering their function. But if the paralysis were so completely limited to one of the orbital nerves as to render it probable that only some minute vessel in the course of the motor-tract had given way, and had involved the adjacent brain-fibres, the absence of all other cerebral symptoms would warrant the hope that considerable improvement, or even complete recovery, might take place.

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* The use of the oblique muscles appears to be to maintain the eyeballs in such a position that their vertical diameters may be always kept parallel to each other during lateral inclination of the head.

By far the most hopeful cases are those where the paralysis of the orbital nerve can be traced to rheumatism; since a well-directed treatment of the general rheumatic diathesis will, in all probability, restore the affected nerve to a healthy condition.

This seems to be the most fitting place for saying a few words about the affection termed *Mydriasis*; for although its manifestation is wholly in the iris, yet the morbid appearance is caused by a loss of motory power in certain branches of the third nerve.

In Mydriasis the pupil is dilated and immovable; and as such a condition is attended with some indistinctness of sight, it often gives rise to extreme alarm, and is regarded as a symptom of 'Amaurosis.' A simple experiment, however, suffices to determine the real nature of the case. Let the patient supply the want of a contracted iris by looking through a small aperture, such as a pinhole in a card held close to the eye. If the case be one of *Mydriasis*—dilated pupil, with a sound retina—he will see perfectly; but if the retina be affected, the aperture will either be quite useless, or at the utmost, afford very little assistance.

The *treatment* of Mydriasis is not easily reduced to precise rules, as the affection may originate in various ways. Exhaustion of nervous energy, dyspepsia, intestinal irritation from worms, &c., rheumatism—all seem in turn to be the exciting cause. Tonics, alone or in combination with purgatives, colchicum, strychnine, as an internal medicine, or applied 'endermically,' powdered ergot of rye, snuffed up the nostril of the affected side,—all these and other means have been employed with but little success. The discovery of the remarkable property of the Calabar bean has at once placed at our command a substance which induces contraction of the pupil as completely as atropine dilates it; but I have not met with a case of true mydriasis in which the Calabar bean, however efficacious at the time, has produced a permanent cure. It is best used by means of little disks of gelatine, on the principle invented by Streatfeild for the application of atropine.

A very contracted and immovable state of the pupil is described by some writers under the name *Myosis*, but it is seldom met with as a simple and independent affection. Some persons who have naturally very small pupillary apertures enjoy such excellent sight, that we must be cautious how we call such a state of the pupils morbid. Extreme contraction of the pupil, however, is a symptom of irritation of the sympathetic nerve; and it would therefore induce the surgeon carefully to examine the condition of this nerve in the neck, as being possibly pressed upon and irritated by some tumour or morbid growth.

STRABISMUS.

The various forms of mal-position of the eyeball just noticed, depending upon more or less sudden paralysis of the ocular muscles, might, according to strict etymology, be classed under *strabismus*; but, practically, the term is restricted to those chronic cases in which habitual mal-position results from irregular action of either the internal or external rectus. The deformity may be defined as a faulty position of the eyes, whereby a separate image falls upon each macula lutea, when the patient endeavours to direct both eyes to one object at the same time.

Strabismus may be either *convergent* or *divergent*. In the former case the eye, or eyes, will be directed towards the nose: in the latter case towards the temple. The strabismus is termed 'single' if one eye only is misplaced, and 'double' when both eyes converge or diverge. In many cases which ordinarily appear as double strabismus, one eye becomes perfectly straight whenever the patient fixes his attention on an object; and the eye which thus for a time acquires a normal position will be found to have the stronger powers of vision.

In other instances of double strabismus both eyes maintain their inverted position, even while the patient is intently observing an object; but if the surgeon suddenly closes one of these convergent eyes, the other at once becomes straight, resuming its inversion as soon as the other eye is opened.

Donders has shown that in the great majority of instances convergent strabismus is associated with hypermetropia; and the divergent form with myopia. Divergent strabismus however is rare, except as a consequence of considerable loss of sight in one eye, persisting for several years.

The *causes* of strabismus are very various. When existing only to a slight degree, coming on only occasionally, and alternating from one eye to the other, it will sometimes be found due to intestinal irritation, such as that arising from worms. In other cases, it may be traced to the temporary cerebral disturbance induced by teething, or to the more persistent form which attends hydrocephalus. An opacity near the centre of the cornea will sometimes cause an eye gradually to turn inwards through a sort of instinctive effort of the organ to bring a clear portion of the cornea into use.

The *treatment* of strabismus, as will be evident from what I have just said as to its causes, must vary according to circumstances. The removal of intestinal irritation; the use of tonics; the employment of convex glasses, to correct extreme hypermetropia;—these, and many other means, may be useful to control strabismus which is only temporary, or which arises from peculiarity in the visual focus of the eyes. In every case a careful ophthalmoscopic examination is the first duty of the surgeon; and he should also take every possible care to ascertain that no organic disease exists in the brain or orbital nerves, and that there is no tumour in the orbit mechanically hindering the movements of the eye.

The *operation* for the cure of strabismus consists in the division of the muscle, which, in consequence of shortening, or too great preponderance in contractile power, is permanently drawing the eye either inwards or outwards. Division of the internal rectus, when first introduced, was performed in the following way. The lids being held apart by an assistant, a small sharp hook was stuck into the sclerotic, close to the inner margin of the cornea, so as to fix the eyeball and draw it outwards. Then the surgeon, raising with a forceps a fold of conjunctiva midway between the cornea and plica semilunaris, divided it vertically with scissors, snipped through the sub-conjunctival tissue covering the tendon of the muscle, passed under it a blunt hook or director, and upon this divided with scissors, or with some kind of knife, either the tendon itself or the adjacent muscular portion of the rectus internus.

As in all other instances of manual surgery, the apparatus for performing this operation gradually became simplified. The spring speculum superseded the elevators held by an assistant; the sharp hook for fixing the globe was laid aside; and it was found that all the cutting could be done with scissors alone. The curious little knives, in every variety of form, which had been invented for dividing the muscle, are now for the most part forgotten; as are also the unseemly disputes about priority in trifling discoveries, and the exaggerated accounts of the uniform success which was stated to have attended the practice of certain strabismus operators.

The defects of this earliest form of operation were a too great separation of the ocular conjunctiva, inducing a subsequent retraction of the semilunar fold, and an over weakening, amounting sometimes to utter loss of action, in the divided muscle.

We still occasionally meet with a fixed and leering eye which recalls the period of the first introduction of the operation in 1840; when, without the ophthalmoscope to facilitate diagnosis, every tyro fancied himself competent to cure a squint.

The deformity arising from retraction of the semilunar fold is now in a great measure obviated by sub-conjunctival division of the muscle. The lids are kept asunder with a spring speculum; and an assistant draws aside the globe, by nipping up with the forceps a little fold of loose conjunctiva near the margin of the cornea, at the opposite side to that on which the muscle is to be divided. Supposing the internal rectus to be chosen for operation, the surgeon, with scissors, divides the ocular conjunctiva horizontally, on a level with the lower edge of the cornea, and extends the incision towards the semilunar fold. Then he snips through the sub-conjunctival tissue, and having clearly exposed the sclerotic, slides upwards, between it and the rectus, a curved director. This serves to raise the muscle and make its fibres tense, and then with scissors the muscle is carefully cut through, close to its insertion into the sclerotic. This section of the muscle cannot be completed at a single stroke, but requires repeated use of the scissors, so that no fibres may be left undivided.

While this sub-conjunctival operation through a horizontal external wound obviates the retraction of the semilunar fold, it involves the risk of an imperfect division of the muscle, which is not exposed to the view of the surgeon. A careful exploration with the blunt hook or director must be made to detect any undivided fibres, before the spring speculum is finally withdrawn.

Graefe divides the conjunctiva a little below the equator of the globe and a few lines from the cornea, almost over the insertion of the tendon; exposes the sclerotic just enough to pass a curved blunt hook beneath the tendon, which is drawn well into the conjunctival wound before using the scissors. It is then snipped through close to its sclerotic attachment; care being taken that the hook, which is sharply curved, is not allowed to perforate the tendon, but is passed well under it. In this operation the tendon is brought quite into view, and is not likely to escape division, which is one of the dangers of the sub-conjunctival operation.

In dividing the *external* rectus, it must be borne in mind that the muscle is broader than the internal rectus, and is also inserted farther from the corneal margin.

Most cases of strabismus require the division of each internal rectus, even when the inversion of the better eye is but slight in comparison with the other. Instances, however, occur in which the inversion is wholly confined to one eye; and in such a case the faulty eye may alone be operated upon.

No absolute rule can be laid down as to the use of chloroform in strabismus operations. In most cases it will be found necessary; but where patients are fitted by age, intelligence and self-command to undergo the operation without it, the doubt which sometimes exists as to whether the muscle has been effectually divided can be at once solved, by directing the patient to attempt inversion of the eye; a test we are unable to employ when insensibility has been induced.

When, in searching for the muscle, the sub-conjunctival areolar tissue has been largely separated, it becomes infiltrated with blood, and forms a little prominence in the wound. The blinking of the lids gradually moulds this into a small button-shaped excrescence, attached by a narrow pedicle, which may be snipped through some weeks after the operation.

REMOVAL OF THE EYEBALL.

Certain diseased conditions of the globe may require a portion of it to be removed, while in other cases its tissues may be so extensively involved, and so much constitutional disturbance may in consequence arise, as to render necessary the total extirpation of the whole organ.

In non-malignant cases this operation is usually undertaken with a prospect of the patient afterwards wearing an artificial eye; and it therefore becomes important to consider whether a total or a partial extirpation will be best adapted to the end in view.

The enlargements which call for removal, on account of the deformity they occasion, are chiefly staphylomatous projections of the cornea or the sclerotic. Under the former term are commonly included projections which have really little or no corneal tissue within them, being formed of the iris coated over with fibrous tissue, after the true cornea has been partially or wholly destroyed by ulceration or sloughing. The sclerotic staphylomata, as they are called, are produced by gradual thinning and distension of the weakened fibres of the part from accumulation of aqueous humour or of serum. In some of the latter cases the eyeball acquires a very large size, and is extremely unsightly, on account of the dark leaden-coloured projections of the sclerotic, and the large tortuous veins which ramify over it. When the cornea has been extensively destroyed by sloughing or ulceration, it very commonly happens that the lens escapes through the breach; when this does not take place, the lens frequently becomes filled with a deposit of phosphate of lime, and this earthy mass, by pressing against the ciliary processes and iris, often causes severe neuralgia. In excising a staphyloma, therefore, the opening should be made sufficiently large to allow the lens, if still existing, to escape.

In operating, the lids must be held apart with a spring speculum or the fingers of an assistant. The surgeon then passes a cataract-knife through the staphyloma, and forms a flap, which he seizes with a forceps, and removes with a second stroke of the knife; if the lens presents at the opening, it is to be quickly tilted out with a scoop, and then the lids are instantly to be closed, and a cold sponge applied firmly over them. This immediate pressure is the most likely means for preventing hæmorrhage from the enlarged choroidal vessels, which sometimes give way the moment the fluid contents of the globe have escaped. Moderate pressure should be kept up until the risk of bleeding has gone by, and then water-dressing will be the only application required till the parts are healed. The portion of the globe left after the excision of a staphyloma gradually shrinks to a nodule, and as soon as this has ceased to be tender, an artificial eye may be applied.

If, in consequence of the sudden removal of the pressure which the accumulated fluids of the globe had been exerting on the choroidal and retinal vessels, the latter give way, and blood fills and distends the cavity of the sclerotic, extreme pain is the result, and it may even be thought desirable at once to extirpate all that remains of the globe, with the view of preventing future suffering. With the object of obtaining a better stump on which to wear an artificial eye, Critchett has modified the operation for staphyloma as follows. He passes several curved needles armed with threads through the sclerotic, above the base of the staphyloma, quite into the vitreous chamber, and brings out their points at the opposite side of the projection. He then cuts away an elliptical portion from the front of the mass, draws the ligatures quite through, and ties them in knots, which then lie just across the line of the closed incision.*

Total extirpation of the eyeball.—This operation, except when malignant disease exists, should never be resorted to, so long as any sight remains in the organ; unless it should be so irritable as to lead the surgeon to fear that, by sparing it, the sight of the fellow-eye may be endangered. Restricted within due limits, and not undertaken through a morbid love of operating, extirpation of the eyeball is a ready means of relieving patients whose whole system may have become impaired by long-continued neuralgia, arising from distension of the globe, or lodgment of foreign bodies within its cavity.

The operation, which was formerly effected by scooping out all the contents of the orbit, has been greatly simplified by the adoption of Bonnet's method, in which the globe alone is removed. A circular incision is made through the conjunctiva and ocular fascia, and then each muscle of the eyeball is successively divided close to its insertion, and the optic nerve just before it pierces the sclerotic.

The operation is usually performed by raising with a hook all the tendons of the ocular muscles, and dividing them before cutting through the optic nerve.

I prefer the following plan, as simpler and more rapid. Having inserted the spring speculum between the lids, and made with curved scissors the usual circular incision of the conjunctiva, I grasp the external rectus and its surrounding tissue with a forceps, and snip them through; an assistant at once seizes the cut tendon close to its insertion, and draws the eye inwards. By sliding one blade of the scissors under the superior oblique and rectus muscle, they can be divided, and then the inferior rectus. The optic nerve is next snipped through, and the globe starts forward. A few strokes of the scissors divide the inferior oblique, internal rectus, vessels, and bands of areolar tissue, and the operation is completed. Cold water and exposure to the air suffice to arrest the bleeding, and then water-dressing is all that is required.

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* *Ophthalmic Hospital Reports,* vol. iv. p. 1.

USE OF CHLOROFORM IN OPHTHALMIC SURGERY.

We may regard chloroform under two aspects: as saving the patient from pain, and as facilitating the manipulations of the surgeon. Now it is well known that operations performed on the globe itself cause little pain, and last but a very short time. Those on the lids, involving as they do the wounding of skin, are of course more painful; but none of them are in this respect comparable to the larger operations of general surgery; and there are few adults who, if properly informed as to the real nature of such operations as those for cataract, artificial pupil, and strabismus, will not readily undergo them without the aid of anæsthetics. There are, however, many timid and anxious persons who are quite unable to go through the operations for artificial pupil and strabismus except under chloroform, and very few without its aid can encounter extirpation of the eyeball. It is also occasionally necessary to induce insensibility in order to examine eyes rendered irritable by disease, or by the presence of foreign bodies. In children all ophthalmic operations are greatly facilitated by the use of chloroform, and some can hardly be performed without it.

If a perfectly passive condition of the eye is so desirable during the delicate operation of flap-extraction, one would naturally expect to find chloroform peculiarly indicated in such a case. But it forms, I think, a special exception, for the following reasons. We have already seen (p. 186) that, when this operation of extraction has been properly performed, a successful result chiefly depends upon the rapidity with which union of the corneal wound can be effected. Now, with every precaution in the administration of chloroform, it will occasionally induce sickness; and the effort of vomiting may cause the vitreous body to escape through the opening just made in the cornea, thus inducing prolapsus iridis, with all its consequent irritation and hindrance to union of the wound. But, even without assuming so extreme a case, we shall find a very serious objection to chloroform in the nausea and disrelish for food which often follow its inhalation, whereby the nutrition and reparative power of the cornea become impaired during the critical twenty-four hours immediately succeeding the operation.

JAMES DIXON.

DESCRIPTION OF PLATES.

The more experience one has had with the ophthalmoscope, the more one feels the impossibility of illustrating by any single drawing the normal fundus of the eye. So many variations of form and colour are compatible with good sight, that such a single drawing can merely serve as a rough indication of what a beginner with the ophthalmoscope is to look for in his first examinations.

Plate I., fig. 1.—A plan of the healthy fundus of the eye in a person of fair complexion. The optic nerve and the yellow spot are not really to be seen at one view, as they are here represented. To see the former the surgeon must tell the patient to turn the eye a little inwards; but to look directly forwards when the yellow spot is to be examined. In persons of fair complexion the site of the spot is usually marked by a tint redder than that of the neighbouring retina, and it is not crossed by any large artery or vein. The fundus of the right eye, which is here represented, is shown reversed, as in the indirect examination, so that the yellow spot, which is really external to the optic nerve, appears to its inner side. (See p. 24.)

Fig. 2.—This is a diagram, not a drawing from nature. It shows in a rough manner the abrupt curving of the vessels, the concave form of the optic disk, and the grey tint which the latter sometimes assumes in the very advanced stage of true glaucoma, or of grey atrophy of the optic nerve. Such a change in the nerve as is here shown, in respect of its outline, its concavity, and its colour, would only be met with when disease—such as chronic glaucoma or primary grey atrophy—had existed a long time. Curving of the vessels, but to a much less extent than is here shown, and with less, if any, change of outline in the disk, is met with during the preliminary stage of glaucoma. The appearances during the acute stage of an attack cannot be depicted, because the change in the corneal epithelium, and the cloudiness of the vitreous humour, which accompany that condition, prevent a clear view of the fundus being obtained. Mr. Burgess is not responsible for these two figures, which are from drawings of my own.

Plate II., fig. 1, shows numerous patches of absorbed choroid, with pigment deposits, from a woman, aged thirty-eight, who, eight or nine years before, had suffered from syphilis. (See p. 107.)

Fig. 2.—Extreme pigmentation of the retina in a man of fifty, who was nearly blind from 'retinitis pigmentosa,' which had been gradually advancing from childhood. The two eyes were almost exactly alike. The optic nerve was pale; and the retinal vessels were very much diminished in size. (See p. 129.)

Plate III., fig. 1, is intended to show the appearances presented by the choroidal vessels when they are exposed to view by the absence of that layer of cells which in a healthy state is interposed between the choroid and the retina. In this figure isolated patches of this layer are still to be seen. The choroidal vessels are represented as rather too uniform in size, but their closely set meshes, with the intervening masses of black pigment, present a marked contrast to the long isolated vessels of the retina. (See p. 26.)

Fig. 2 shows very well the homogeneous white disk and contracted vessels of an optic nerve which has undergone 'white atrophy.' (See p. 124.)